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MINIMUM PROPERTY REQUIREMENTS

FOR PROPERTIES OF

ONE OR TWO LIVING UNITS

LOCATED IN THE

STATE OF ILLINOIS

NATIONAL HOUSING AGENCY

FEDERAL HOUSING ADMINISTRATION

CHICAGO AND SPRINGFIELD INSURING OFFICES

FEDERAL HOUSING ADMINISTRATION
605 Illinois Building
Springfield, Illinois

Attached hereto please find "Minimum Property Requirements for Properties of One or Two Living Units Located in the State of Illinois" published July, 1947, together with revisions to date in loose leaf form.

The revised sheets should be inserted and superseded sheets marked void, as compliance with the revisions will be required.

Taken care of. R.L. Talmadge.

ROBERT E. TERHUNE
District Director

MINIMUM PROPERTY REQUIREMENTS

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FHA Form No. 2250. Revised July 1947

Notice to Holders of This Book

This book has been bound so that it may be taken apart and placed in a standard loose-leaf binder. It will be revised from time to time by page or paragraph when necessary. Those who are interested in keeping the book up to date may obtain such revisions from the local FHA office.

These Minimum Property Requirements supersede those contained in:

1. Property Standards and Minimum Construction Requirements for dwellings located in the State of Illinois dated April 15, 1942.

2. Amendments to the Minimum Construction Requirements for all new dwellings, dated January 21, 1943.

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FOREWORD

These Federal Housing Administration "Minimum Property Requirements for Properties of One or Two Living Units" set forth minimum planning and construction requirements to apply to a residential property, including the land and all improvements thereon, which is offered or proposed to be offered to the Federal Housing Administration as security for an insured mortgage loan.

They are confined in their application to the individual property within its metes and bounds. They do not include requirements for off-site improvements except a general requirement for the provision of streets and essential utilities at the site at the time the property is accepted as security for an insured mortgage loan.

The requirements for residential properties containing more than two living units are found in the booklet entitled. "Minimum Property Requirements for Properties of Three or More Living Units."

APPLICATION

Minimum Property Requirements is the title used to designate the "General Acceptability Requirements", the "Minimum Planning Requirements" and the "Minimum Construction Requirements" when referred to collectively.

These Minimum Property Requirements apply in the following manner to each property consisting of one or two living units and covered by a single mortgage:

Proposed Construction, including any clearly indicated provisions for future expansion, shall comply with the "Minimum Property Requirements" in their entirety.

Existing Construction shall comply with the "General Acceptability Requirements", and with the stated Objectives of the "Minimum Planning Requirements" and the "Minimum Construction Requirements".

Alterations and Additions. New work involved in alterations and additions to existing construction shall comply with the "Minimum Property Requirements" in their entirety.

REFERENCE TO OTHER REQUIREMENTS AND STANDARDS

Multifamily Properties. The requirements contained in the booklet entitled "Minimum Property Requirements for Properties of Three or More Living Units" shall apply to *all* such multifamily properties regardless of the type of dwelling or dwellings included therein.

Minimum Street Improvement Requirements. The Minimum Street Improvement Requirements relate primarily to the construction of improvements in the street rights-of-way and apply in residential developments in which properties are offered or are to be offered to the Federal Housing Administration as security for insured mortgage loans. The requirements apply in their entirety to all residential developments under centralized control. For residential developments not under centralized control, they apply to the extent determined by the Chief Underwriter.

MINIMUM PROPERTY REQUIREMENTS

FOR PROPERTIES OF

ONE OR TWO LIVING UNITS

GENERAL ACCEPTABILITY REQUIREMENTS

GENERAL

100. These General Acceptability Requirements together with the Administrative Rules and Regulations are the eligibility rules and apply to all non-farm one- and two-family properties whether proposed or existing construction.

SITE CONDITIONS

101. The property shall not be subject to hazards such as objectionable smoke, noxious odors, unusual noise, the possibility of subsidence or the probability of flood or erosion.

THE PLOT

102. All land offered as security for an insured mortgage shall comprise a single plot except that a dwelling site with a secondary site for an appurtenant garage or for other use essential to the dwelling will be acceptable provided the two plots are in such proximity as to comprise a readily marketable real estate entity.

ACCESS

103–A. Access to the Plot. Direct vehicular access to the property shall be provided by means of an abutting improved public street or way or improved and permanently maintained private street or way which is protected by a permanent easement. Sole vehicular access shall not be by an alley. The width and construction of streets or ways shall be suitable for the vehicular traffic requirements of the properties served. Dead-end streets shall include adequate vehicular turning space.

103–B. Access to the Dwelling. Each dwelling shall be provided with a means of access for the removal of garbage and trash and for the delivery of fuel. Access for these services shall be provided at the rear of a row dwelling by means of an alley, easement or open passage through dwelling, unless provided for by other satisfactory and acceptable means.

103–C. Access to Living Units. A means of access to each living unit shall be provided without passing through any other living unit. Acceptable means of access to the rear yard shall be provided for each living unit without passing through any other living unit.

TYPES OF ELIGIBLE DWELLINGS

104–A. The types of dwellings eligible for consideration are: Detached, semidetached, row and end-row dwellings. Each of these types may contain one or two living units.

104–B. A semidetached, row or end-row dwelling shall be separated from an adjoining dwelling or dwellings by a party or lot line wall extending the full height of the building. The party or lot-line walls shall be designed as bearing walls, be constructed of masonry and have no through openings. A party wall shall be so constructed that the dwelling on either side may be razed without impairment of structural stability of the wall.

104–C. Each dwelling must be capable of individual use and maintenance without trespassing upon adjoining properties. Utilities and service facilities must be independent for each property.

METHOD OF DETERMINING NUMBER OF LIVING UNITS

105–A. A dwelling shall provide living facilities for at least one family but not more than two families. If more than two families are involved see Minimum Property Requirements for Properties of Three or More Living Units.

105–B. In determining the number of living units, the following rules shall be used in considering properties with living facilities in addition to the required living unit for one family as set forth in 302. These rules shall also be used to determine the number of living units contaned in any property submitted as security for an insured mortgage, since application of the Minimum Property Requirements for properties of one or two living units, or those for properties of three or more living units, will depend on such determination.

105–C. A habitable room or group of habitable rooms containing cooking facilities, or provisions for such facilities, shall be counted as a living unit whether or not designed for use of occupants such as janitors, caretakers, servants, or guests, and whether or not they are included in the main building. However, disconnected or isolated habitable rooms, without cooking facilities or provisions for such facilities, which are for use of servants or guests, and which are obviously auxiliary to a living unit shall not be counted as a separate living unit.

105–D. Other arrangements of habitable rooms, single or grouped, but without cooking facilities or provisions for such facilities, shall be counted as separate living units if such rooms are not designed as, or obviously not auxiliary to, or are not connected with a living unit but, in fact, constitute a separate living unit.

NONRESIDENTIAL USE

106–A. Any nonresidential use of the property shall be subordinate to the residential use and character of the property.

106–B. The area of the dwelling and accessory buildings including storage space, designed or used for nonresidential purposes, shall not exceed 25% of the total floor area. The total floor area shall include the area of all floors and such portions of basements and finished attics, designed or used for both residential and nonresidential purposes. The computed nonresidential floor area shall include all space which is essential to the proper functioning of the nonresidential area. If hallways or similar spaces serve both residential and nonresidential areas, they shall be considered nonresidential area in determining the above percentage.

106–C. A property, any portion of which is designed or used for nonresidential purposes is ineligible if the type or extent of the nonresidential use is inharmonious with the residential character of the property for family occupancy. In addition to most business and commercial enterprises and certain types of professional activities, inharmonious uses include commercial rooming or boarding houses, tourist houses or cabins, club houses, sanitariums and fraternity houses.

106–D. A property is ineligible if the nonresidential use adversely affects the desirability of neighboring properties for residential use for family occupancy.

106–E. A property which is designed or used for the manufacture, handling or storage of highly combustible or inflammable materials is ineligible.

106–F. Temporary nonresidential use shall not render a residential property ineligible so long as the design of the dwelling is not changed, and provided that the future use of the dwelling as a residence is not impaired by the nonresidential use.

SERVICES AND FACILITIES

107–A. Each living unit shall contain provisions for each of the following:

1. A continuing supply of safe and palatable water;
2. Sanitary facilities and a safe method of sewage disposal;
3. House heating adequate for healthful and comfortable living conditions;
4. Domestic hot water in quantity adequate to serve appropriate fixtures; and
5. Electricity for artificial lighting and to serve electrical equipment used in the dwelling.

DEFECTIVE CONDITIONS

108. Unacceptable construction, or evidence of continuing settlement, dampness, leakage, decay, termites, or other conditions impairing the safety or sanitation of the dwelling, shall render the property ineligible as security for an insured mortgage until such defects or conditions have been remedied and the probability of further damage eliminated.

INFLUENCE ON ADJOINING PROPERTIES

109. Properties possessing characteristics which tend to produce undesirable community conditions or threaten to influence adversely the values of neighboring properties are not eligible for mortgage insurance.

MINIMUM PLANNING REQUIREMENTS

PLOT PLANNING REQUIREMENTS

GENERAL

200–A. Drawings and Specifications. For required drawings and specifications, see Appendix D.

200–B. Compliance with Local Ordinances and Regulations.

1. The development and use of land shall conform to all applicable laws, ordinances and regulations (including deed restrictions and covenants running with the land) which relate to the utilization of land.

2. Where change in present zoning status is required, evidence of the acceptability of such change to local authorities must be submitted prior to the acceptance of an application for processing by this Administration.

3. The minimum requirements, established herein shall not be construed as lowering the standards established by the local laws, ordinances, or regulations. Whenever such local requirements contain more stringent provisions than any of the minimum requirements of the Federal Housing Administration, the more stringent requirement shall govern.

4. The Federal Housing Administration does not assume responsibility for determining compliance with local requirements.

200–C. Optional Requirements. These requirements are essentially minimum, consequently the Chief Underwriter may require compliance with higher requirements than those contained herein, to obtain conformance with standards consistent with the type and size of property under consideration.

200–D. Changes After Commitment. No changes, except for acceptable minor variations, from the plot plan arrangement upon which a commitment has been based, will be permitted without first obtaining written approval from the FHA field office.

MINIMUM LOT AREAS

201–A. Objective. *The objective of lot area requirements is to provide for adequate open area on the property to assure privacy, adequate natural light and ventilation to each living unit, and to provide sufficient area for outdoor uses essential to the type of dwelling under consideration.*

201–B. Lot Areas. Lot areas shall be not less than the following:

1. Detached dwelling, one-family: 4000 square feet.
In Cook County: 3000 square feet.
2. Semidetached dwelling, one-family: 3000 square feet.
In Cook County: 2500 square feet.
3. End-row dwelling one-family: 3000 square feet.
In Cook County: 2500 square feet.
4. Row dwelling, one-family: 2000 square feet.

5. When housing for two families is provided on one property, the areas established in 1, 2, 3 and 4 shall be increased 50 percent.

6. When individual water supply or sewage disposal or both are involved, lot areas shall be adequate to comply with the FHA "Requirements for Individual Water-Supply and Sewage-Disposal Systems", for the State in which the property is located, but in no case less than the above minimums.

LOT COVERAGE

202–A. Objective. *The objective of coverage requirements is to assure sufficient open area on the lot in relation to the area covered by buildings to assure privacy, adequate natural light and ventilation to each living unit, and sufficient space for laundry drying, gardening, landscaping, outdoor living or other uses considered essential to the type of dwelling under consideration.*

202–B. Lot Coverage. Maximum area of plot which may be used for:

1. Detached dwelling on:
   a. Interior lot, 30 percent. In Cook County, 35 percent.
   b. Corner lot, 35 percent. In Cook County, 40 percent.

2. Semidetached dwelling, 35 percent.

3. End-row dwelling, 35 percent.

4. Row dwelling, 35 percent.

202–C. Deduction from Building Area. When a one-story attached or detached garage is located on the same plot with the dwelling, the area of the garage not to exceed 200 square feet for a one car garage and 400 square feet for a multi-car garage may be deducted from the total building area in computing the lot coverage. No deduction permitted for a built-in garage or for garage having habitable rooms above.

YARDS—General

203–A. Objective. *The objective of yard requirements is to obtain sufficient distances between the dwelling on the subject property and obstructions on adjoining properties to assure privacy, adequate natural light and air, and convenient access to the dwelling, and to provide for circulation around the dwelling and for such uses of the yard spaces as are considered essential to the type of dwelling under consideration.*

203–B. Determination of Continued Assurance of Open Spaces. Location of future buildings on adjoining unimproved properties shall be considered as assured when fixed by codes, laws, restrictions, recorded permanent easements, or by established and accepted practice in the neighborhood in which the property is located.

203–C. Determination of Compliance When Yard Adjoins an Alley. Width of side and rear yard adjoining an alley shall be measured from the building to the near side of the alley.

203–D. Determination of Yard Requirements on Corner Lot. The narrower side of the lot abutting a street shall be considered the front regardless of the location of the principal entrance of the dwelling.

203–E. Determination of Yards on Irregularly Shaped Lots. When any wall of a dwelling located on an irregularly shaped lot does not parallel the lot line which the wall faces, compliance with the minimum yard requirements shall be determined as follows:

1. If the wall contains a required window of a habitable room, the yard width at the required window shall comply with the applicable requirements.

2. In all other cases the yard width at every point shall be at least equal to the minimum required for front, rear or side yards, whichever is applicable.

The same principle shall apply in determining the width of courts and distance between buildings on the same plot, when walls are not parallel.

FRONT YARDS

204. Minimum distance from front line of dwelling to building line on opposite side of street, 60 feet.

REAR YARDS

205. Minimum distance from main building to rear lot line, 15 feet.

SIDE YARDS. *Applicable to Both Interior and Corner Lots.*

206–A. Detached Dwellings.

1. Sum of side yards: Minimum 10 feet. In Cook County only: Minimum 6 feet.

2. Side yards faced by required windows of habitable rooms: Minimum width of each side yard 5 feet, except that a minimum width of 3 feet is permitted in connection with residential developments when established controls provide assurance that the sum of the side yards and the distance between buildings will be a minimum of 10 feet. In Cook County, side yards faced by required windows of habitable rooms, minimum width of each side yard, 3 feet. See 203–B.

3. All other side yards: Minimum width 3 feet.

206–B. Semidetached Dwellings. Width of side yards; minimum 8 feet. In Cook County; minimum 4 feet.

206–C. End-row Dwellings. Width of side yard; minimum 8 feet. In Cook County; minimum 4 feet.

206–D. Garages.

1. One-story detached or attached garages: Minimum 3 feet, except that the garage may be built to property line in residential developments where established controls provide that no required windows of habitable rooms will be affected.

2. One-story attached garages, including those connected to the main dwelling by a roofed terrace or porch, may be disregarded in determining the sum of the widths of the side yards provided no required windows of habitable rooms are affected.

206–E. Driveway. In all cases when a side yard is used for a driveway, that side yard shall be not less than 8 feet wide.

COURTS

207–A. Objective. *The objective of court requirements is to assure adequate natural light and ventilation to all rooms facing on courts without impairment of privacy.*

207–B. Outer Courts.

1. When a required window of a habitable room opens on an outer court and:

a. Faces an open end of court; minimum court width, 5 feet.

b. Faces an existing or allowable future side wall of court: less than two stories high, minimum court width, 8 feet; for dwellings two stories high, 10 feet.

2. When nonrequired windows in habitable rooms open on courts: minimum court width 6 feet.

3. The requirements in 1 and 2 do not apply when the depth of an outer court is 50 percent or less of the width.

207–C. Inner Courts. Inner courts are not acceptable as a means of providing required natural light and ventilation.

207–D. Irregularly Shaped Courts. See 203–E.

DISTANCE BETWEEN BUILDINGS ON SAME PLOT

208–A. Objective. *The objective of requirements for distance between buildings is to provide adequate natural light and ventilation to all rooms with windows facing the opposing buildings without impairment of privacy.*

208–B. Distance between a dwelling wall containing a required window of a habitable room and another dwelling or an accessory building: 10 feet minimum.

208–C. Distance between building walls in all other cases: Six feet minimum.

208–D. When opposite walls are not parallel, see 203–E.

DRIVEWAYS AND WALKS

209. See Lot Improvement Requirements, Sec. 800.

BUILDING PLANNING REQUIREMENTS

GENERAL

300–A. Drawings and Specifications. For required drawings and specifications, see Appendix D.

300–B. Compliance With Local Regulations.

1. All improvements of the land including buildings and all appurtenances thereto shall conform to all applicable laws, ordinances and regulations (including deed restrictions and covenants running with the land) which relate to the safety and sanitation of the buildings. The minimum requirements established herein shall not be construed as lowering the standards established by the local laws, ordinances, or regulations. Whenever such local requirements contain more stringent provisions than any of the minimum requirements of the Federal Housing Administration, the more stringent requirement shall govern.
2. The Federal Housing Administration does not assume responsibility for determining compliance with local requirements.

300–C. Optional Requirements. These requirements are essentially minimum, consequently the Chief Underwriter may require compliance with higher requirements than those contained herein, to obtain conformance with standards consistent with the type and size of property under consideration.

300–D. Changes After Commitment. No changes, except for acceptable minor variations, from the drawings and specifications of the dwelling upon which a commitment has been based, will be permitted without first obtaining written approval from the FHA field office.

LIGHT AND VENTILATION

301–A. Objective. *The objective of light and ventilation requirements is (a) to assure satisfactory and healthful living conditions by providing natural light and ventilation in sufficient volume, proportioned to the size and intended use of the rooms; and (b) to provide sufficient ventilation to spaces, such as attics and basementless areas, to prevent conditions conducive to decay and deterioration of the structure.*

301–B. General.

1. Natural light and ventilation shall be provided in all habitable rooms by means of windows or their equivalent located in outside walls.

2. Windows which provide all or part of the natural light and ventilation required herein are considered required windows. All windows in addition to these are considered nonrequired windows.

3. The area of glazed portions of doors in exterior walls may be included in determining compliance with the following requirements, except that an exterior door in a kitchen will not be acceptable as the only means of providing ventilation.

4. Any glazing material, such as glass block, may be used to provide natural light if the area is sufficient to admit an amount of light equivalent to that transmitted by the required area of clear glass; in no case less than the area required for clear glass.

5. In determining required glass area, measure the actual glass area disregarding muntins. When the sill of a basement window is below the extended line of the finished grade at the window, only half of the glass area of that window shall be included in determining the required glass area. See 308 for areaways.

6. Row dwellings shall be not more than two habitable rooms deep from outside wall to outside wall except for the condition permitted by 301–D.

301–C. Habitable Rooms. Required windows in each habitable room:

1. Total glass area: not less than 10 percent of floor area of room.

2. Ventilating area: not less than 4 percent of floor area of room.

3. If windows open on covered porches and terraces, or are in rooms any portion of which is more than 18 feet from a window, the glass area shall be not less than 15 percent of the floor area of the room.

4. If windows open on a glass enclosed porch, the glass area of required windows shall be not less than 20 percent of the floor area of the room; such windows shall not be included in determining required ventilating area.

301–D. Alcoves.

1. Unless separately lighted and ventilated by windows which provide the required glass and ventilating area, include any alcove adjoining a habitable room as part of that room in computing required glass and ventilating area.

2. An alcove may receive light and ventilation from the windows of an adjoining habitable room only when the common wall between the alcove and the habitable room contains an opening, the area of which is not less than 80 percent of the area of the entire wall on the alcove side.

301–E. Bathroom. Provide light and ventilation by one of the following means:

1. Window or windows located in an exterior wall facing a street, alley, yard or outer court:
   a. Glass area not less than 10 percent of floor area; minimum 3 square feet.
   b. Ventilating area not less than 4 percent of floor area.

2. Skylights permitted in row dwellings to serve top floor bathrooms only: shall provide light and ventilation to outside air equal to that required in E–1.

3. If a compartment containing any one fixture opens directly into the bathroom, it shall be considered a part of the bathroom floor area and may be lighted artificially and ventilated into the bathroom.

301–F. Water Closet Compartments. A compartment containing a lavatory or water closet or both, which is in addition to a bathroom, shall be ventilated by:

1. Method as required for bathrooms in 301–E; or

2. A duct or ducts: area equal to 2 square inches for each square foot of floor area; minimum area, 48 square inches; minimum dimension 3½ inches; located in or close to ceilings; installed continuous to and above the roof; and connected to a louvered vent stack or a mechanical device for exhausting air. If an electrically operated fan is provided, the duct need not project above roof but must discharge to the outside air.

301–G. Open Basements. Provide light and ventilation by windows or doors in exterior walls with both glazed and ventilating area not less than 2 percent of the floor area.

301–H. Laundries and Recreation Rooms. Provide light and ventilation by windows or glazed doors in exterior walls:

1. When located in a separately enclosed space in the basement, glazed and ventilating area not less than 4 percent of floor area. See 301–G above.

2. When located above basement level, glazed area not less than 10 percent of floor area and ventilating area not less than 4 percent of floor area.

301–I. Utility Rooms. (If heater is included, see 301–J) Ventilate utility rooms by windows or doors in exterior walls having ventilating area not less than 2 percent of floor area.

1. Windows or doors in exterior walls having ventilating area not less than 2 percent of floor area; or

2. Duct or ducts, minimum total free area, 2 percent of floor area.

301–J. Heater Rooms. When sufficient air for proper combustion of fuel in the heating equipment cannot be expected to be supplied by infiltration directly or indirectly from outside the dwelling, provide fixed ventilation by means of a duct arranged to supply air from outside. Duct shall be screened and shall have a free area at least equal to the free area of flues or vents to which the fuel burning equipment is connected.

301–K. Basementless Spaces.

1. Where the floor construction above is of wood or metal provide at least two foundation wall vents to assure a total ventilating area equivalent to one square foot for each 15 lineal feet of wall enclosing that area.

2. Locate one vent at or near each corner to provide through ventilation wherever possible. No vents are required for a basementless space adjoining a basement where the common wall below the joists is at least 50 percent open, provided the total area of ventilating openings in the basement space is not less than 2 percent of the combined basement area and basementless space.

3. In each vent opening install corrosion-resistant screening, mesh not less than 8 per inch.

301–L. Attics. Provide effective fixed ventilation in all spaces between roofs and top floor ceilings, by screened louvers or by other means acceptable to the Chief Underwriter. This applies also to space between ceiling and flat roofs. Net ventilation area for each separate space shall be not less than 1/300 of the horizontal projection of the roof area. Locate vents to provide effective cross-ventilation. Use corrosion-resistant screening over openings, mesh not less than 16 per inch.

SPACE REQUIREMENTS

302–A. Objective. *The objective of space requirements is to assure (a) that each living unit provides complete living facilities ordinarily considered necessary to a permanent home, arranged and equipped to provide suitable and desirable living, sleeping, cooking and dining accommodations, and adequate storage and sanitary facilities; and (b) rooms of such size and so planned as to permit the proper placing of adequate furniture and equipment, appropriate to and essential for the use of the occupants.*

302–B. General.

1. Each living unit shall contain not less than one bathroom and three habitable rooms, at least one of which shall be a bedroom.

2. Measurements are based upon distances between finish floor surface and rough ceiling surface (bottom of joists) and between rough wall or rough partition surfaces.

3. The area occupied by a stair shall not be considered a part of any habitable room.

4. Under sloping ceilings, the area with less than 5 feet clear headroom shall not be included in determining the required floor area.

302–C. Minimum Size of Spaces. Provide not less than the areas indicated for each of the following:

	Min. Area Sq. Ft.
1. *Living-Dining-Cooking.*	
a. Living room	150
b. Living-dining combination	160
c. Living-dining-kitchen combination	
in living unit of 1-bedroom	210
in living unit of more than 1-bedroom	220
d. Kitchen-dining combination	90
e. Kitchen in living unit of 1-bedroom	50
f. Kitchen in living unit of more than 1-bedroom	60
g. Dining room or dining alcove	70
2. *Bedrooms.*	
a. Major bedroom: minimum floor area	100
b. Second bedroom of living units of over 2-bedrooms	100
c. Second bedroom of 2-bedroom living units	70
3. *All other Habitable Rooms.* Minimum floor area	70

4. *Bathroom.* Adequate for water closet, lavatory, and tub. Arrangement of fixtures shall provide at least 90° door swing and comfortable use of each fixture.

5. *Closets.*

a. General. At least half of the required floor of each required bedroom closet and coat closet shall be not more than 8 inches above the floor level of the room into which it opens. Each bedroom closet and coat closet shall provide at least 5½ feet clear clothes hanging space above the closet floor.

b. Bedroom closets. Provide each bedroom with at least one closet having a minimum:

Depth: 2′ 0″
Floor area: 6 square feet
Height: 6 feet above closet floor
One shelf, rod and hooks

c. Coat closet. Provide each living unit with a coat closet readily accessible to the living room, preferably near the front entrance; of same minimum size and equipment as bedroom closets.

d. Linen closet. Provide each living unit with a linen closet separate from other closets, near bedrooms; minimum size, 14″ x 18″; minimum 5 shelves, approximately 12″ o. c.

6. *Kitchen Storage.*

a. Each kitchen shall be provided with shelf space at least 11 inches deep for dishes and miscellaneous kitchen storage; for one bedroom living units, minimum 18 lineal feet, for two bedroom living units, minimum 24 lineal feet, for three or more bedroom living units, minimum 30 lineal feet. At least half of this shelf space shall be enclosed by cabinet doors. Such required shelving shall be located not lower than 3 feet and not higher than 6 feet 6 inches above finished floor. Shelving higher than 6 feet 6 inches above finished floor may be counted as general storage In addition to the above at least 6 lineal feet of base cabinets with doors and 6 lineal feet of counter top work space shall be provided. Sink drain boards may be included as counter top work space.

7. *General Storage Space.*

a. Minimum total volume for each living unit in addition to 5 and 6 above: 150 cubic feet plus 50 cubic feet per bedroom.

b. Height: space less than 4 feet in clear height will not be considered as providing storage space under these requirements.

c. Location: Closets, utility rooms, basement, or conveniently accessible attic or garage. That portion of storage space which is necessary for equipment, passage and work space shall not be included in determining the required volume. Space in garage or located elsewhere outside the dwelling shall be such that it can be locked. When attic space is to be used for storage, the area required for storage shall be floored and shall have access to floor below by means of a permanent or disappearing stairway.

8. *Fuel Storage.* Facilities shall be provided for economical delivery and handling of fuel, and for adequate storage. The storage facilities shall be provided within the dwelling or buried under ground or provision shall be made for concealment satisfactory to the Chief Underwriter.

9. *Space for heating.*

a. Provide space within the dwelling for heating unit or system.

b. Provide clearances for maintenance and repair.

c. Provide clearances for safety, determined by insulation of heater and combustibility of walls, floor and ceiling. Heat generated shall not raise the surface temperature of combustible walls, floor or ceiling above 160 degrees F.

10. Utility Rooms in basementless dwellings. Utility room shall have an area with sufficient space to accommodate the equipment proposed for the utility room, with sufficient space around the equipment for safety, access, maintenance and repair. If general storage is contemplated in the utility room there should be an unobstructed volume equal to that required by 302-C-7.

Above portion in this style type revised January 1948 - MPRs, 1 or 2 L. U. for State of Illinois.

Void

c. Coat closet. Provide each living unit with a coat closet readily accessible to the living room, preferably near the front entrance; of same minimum size and equipment as bedroom closets.

d. Linen closet. Provide each living unit with a linen closet separate from other closets, near bedrooms; minimum size, 14″ x 18″; minimum 5 shelves, approximately 12″ o. c.

6. *Kitchen Storage.*

a. Each kitchen shall be provided with shelf space at least 11 inches deep for dishes and miscellaneous kitchen storage; for one bedroom living units, minimum 18 lineal feet, for two bedroom living units, minimum 24 lineal feet, for three or more bedroom living units, minimum 30 lineal feet. At least half of this shelf space shall be enclosed by cabinet doors. Such required shelving shall be located not lower than 3 feet and not higher than 6 feet 6 inches above finished floor. Shelving higher than 6 feet 6 inches above finished floor may be counted as general storage In addition to the above at least 6 lineal feet of base cabinets with doors and 6 lineal feet of counter top work space shall be provided. Sink drain boards may be included as counter top work space.

7. *General Storage Space.*

a. Minimum total volume for each living unit in addition to 5 and 6 above: 150 cubic feet plus 50 cubic feet per bedroom.

b. Height: space less than 4 feet in clear height will not be considered as providing storage space under these requirements.

c. Location: Closets, utility rooms, basement, or conveniently accessible attic or garage. That portion of storage space which is necessary for equipment, passage and work space shall not be included in determining the required volume. Space in garage or located elsewhere outside the dwelling shall be such that it can be locked. When attic space is to be used for storage, the area required for storage shall be floored and shall have access to floor below by means of a permanent or disappearing stairway.

8. *Fuel Storage.* Facilities shall be provided for economical delivery and handling of fuel, and for adequate storage. The storage facilities shall be provided within the dwelling or buried under ground or provision shall be made for concealment satisfactory to the Chief Underwriter.

9. *Space for heating.*

a. Provide space within the dwelling for heating unit or system.

b. Provide clearances for maintenance and repair.

c. Provide clearances for safety, determined by insulation of heater and combustibility of walls, floor and ceiling. Heat generated shall not raise the surface temperature of combustible walls, floor or ceiling above 160 degrees F.

10. *Utility Rooms* in basementless dwellings.

a. Utility room with minimum area of 100 square feet is required in all basementless dwellings.

HABITABLE BASEMENT ROOMS

303–A. Objective. *The objective of requirements for habitable basement rooms is to assure that habitable basement rooms will be free of those features which create undesirable living conditions.*

303–B. Comply with requirements for main floor rooms with respect to privacy, light and ventilation, floor area, ceiling height, etc.

303–C. Finish floor below the adjoining outside finish grade: maximum 2′ 6″ at required windows.

ACCESS AND PRIVACY

304–A. Access.

1. *Attics.* Provide access to attics by means of scuttles, disappearing or permanently installed stairways. See 408–D.
2. *Basementless Spaces.* Provide access openings not less than 18″ x 24″.
3. *Basements:*

a. Provide interior stairway to basement.

b. When solid fuel is used, provide direct access by stairway to outside grade.

304–B. Privacy.

1. *Objective. The objective of privacy requirements is to assure that the location of exterior openings in relation to exterior conditions, and the interior arrangement of rooms particularly with reference to access to bathrooms from bedrooms, provide a degree of privacy commensurate with desirable living conditions.*
2. *General.*

a. Exterior openings shall be located in relation to exterior conditions, including existing or possible future adjacent buildings or other living units, so as to provide an acceptable degree of privacy.

b. The interior arrangement of rooms, particularly with respect to bedrooms, bathrooms, and toilet compartments shall be such as to provide an acceptable degree of privacy.

3. *Bedroom privacy.*

a. The bedroom in one-bedroom living units and at least two bedrooms in all other living units shall have access to a bathroom without passing through another habitable room.

b. Each bedroom shall have access to a bathroom without passing through another bedroom.

c. Each habitable room shall have access to each other habitable room without passing through a bedroom or bathroom.

4. *Nonacceptable bathroom arrangements.*

a. An only bathroom opening directly into a kitchen.

b. Bathroom in the basement as the only one serving a living unit located on another floor level.

CEILING HEIGHTS

305–A. Objective. *The objective of ceiling height requirements is to assure free circulation of a sufficient volume of air, and further, in rooms with sloping ceilings, to provide headroom adequate for the placing of and access to appropriate furniture in comfortable arrangement.*

305–B. Minimum Ceiling Heights.

1. *Basement.* 6′–10″ clear under joists. See 303–B.

2. *Main floor.* 7′–6″ clear.

3. *Second story.* 7′–6″ clear except that under sloping ceiling the minimum shall be 7′–6″ for one-half the required room area. See 302–B.

DOORS

306–A. Exterior Doors.

1. *Minimum sizes.*
   a. Main entrance doors: 2′–10″ wide.
   b. Service exterior doors: 2′–8″ wide.
   c. Height: 6′–6″.
   d. Thickness: 1¾ inches.

306–B. Interior Doors.

1. Provide a door for each opening to a bedroom, bathroom, closet and toilet compartment.

2. *Minimum sizes.*
   a. All habitable rooms: 2′–6″ wide.
   b. Bathrooms and closets other than linen and broom closets: 2 feet wide.
   c. Height: 6′–6″.

STAIRWAYS

307–A. Objective. *The objective of stairway requirements is to obtain stairs which provide safety of ascent and descent and which are so designed, arranged and installed as to afford adequate headroom and space for the passage of furniture.*

307–B. Design.

1. *Headroom.* See details 39 and 40. Continuous clear headroom measured vertically from front edge of tread to a line parallel with stair run:
   a. Main stairs: Minimum 6′–6″.
   b. Basement and service stairs: Minimum 6 feet.

307–B. Design. *Continued.*

2. *Width.*
   a. Main stairs: Minimum 2′–9″, clear of handrail.
   b. Basement and service stairs: Minimum 2′–6″ clear.
3. *Treads.*
   a. Main stairs: Minimum run 9 inches; minimum width of tread including nosing, 10¼ inches.
   b. Basement and service stairs: Minimum run 9 inches; minimum width of tread including nosing, 9½ inches.
4. *Rise.*
   a. Maximum height, main stair, 8¼ inches; basement stair, 8½ inches.
   b. All riser heights to be same in any one stair.
5. *Winders.* Design winders so that tread width 18 inches from converging end will be the same as the tread width on the straight run.
6. *Landings.* Width not less than that of stair. A landing is required at top of any stair run having a door which swings toward the stair.
7. *Handrail.* Install continuous handrail on at least one side of each run on all stairs. The railing on an open stair complies with this requirement.
8. *Railings.* Install continuous railings on all open sides of all runs of exterior steps which are attached to the dwelling and have more than 3 risers.
9. *Guard Rail.* Provide guard rail around stairwell in unfinished attic.
10. *Areaway Party Wall.* In semidetached and row dwellings, provide individual stairs to basement entrances. If basement stairs for adjoining properties are to be built in the same excavation, the stairs shall be separated by either a 6-inch concrete wall or an 8-inch masonry wall centered on the common property line.

AREAWAYS

308. Minimum dimension measured horizontally, at right angle to face of building wall at center line of the opening, 1 foot. Increase this dimension 1 inch for each inch of depth over 1 foot from top of area to the sill. Head of window, in all cases, shall be above top of areawall. Bottom of areaway shall be at least 6 inches below the sill of the opening and shall be effectively drained.

PORCHES, TERRACES AND ENTRANCE PLATFORMS

309–A. Least dimension: 3′–6″.

309–B. Guard rails required on all edges except at steps when:
   a. Floor is more than 18 inches above adjoining finish grade.
   b. Floor is more than 8 inches above adjoining finished grade and steps do not occur at edge of platform directly in front of door.

GARAGES

310. When garages are included, comply with the following:

1. *Minimum sizes* (inside)	*1 car*	*2 car*
Width	10′–0″	17′–6″
Length	19′–0″	19′–0″

SCREENS

311. Install screens on all ventilating openings, such as windows, doors, and louvres, including those in attic, utility room and basement.

MINIMUM CONSTRUCTION REQUIREMENTS

These Minimum Construction Requirements include all sections in the Structural Requirements, Heating Requirements, Plumbing and Sanitation Requirements, Electric Requirements, and Lot Improvement Requirements. The provisions contained under 401–General of the Structural Requirements are also applicable to the Heating, Plumbing and Sanitation, Electric and Lot Improvement Requirements.

STRUCTURAL REQUIREMENTS

400. Objective. *The objective of structural requirements is to obtain a well-built and durable dwelling which provides a weather-resistant shelter.*

The attainment of this objective requires that (a) all portions of the structure subjected to exterior exposure be of such materials and be so constructed and protected as to prevent entrance or penetration of moisture and the weather; (b) adequate precautions be taken to properly protect materials and construction from damage by ordinary use and by decay, corrosion, termites and other destructive elements; (c) workmanship be of a quality equal to good standard practice and materials used be of such kind and quality as to assure reasonable durability and economy of maintenance, all commensurate with the class of dwelling under consideration; (d) all members and parts of the construction be properly designed to carry all loads imposed without detrimental effect on finish or covering materials; (e) each member be correctly fitted and connected; (f) the structure be adequately braced against lateral stresses; and (g) adequate precautions be taken to protect against fire and accidents.

GENERAL

401–A. Drawings and Specifications. For required drawings and specifications, see Appendix D.

401–B. Application.

1. Compliance with the items listed under the various sections of the minimum construction requirements which are applicable to the property under consideration is mandatory for all proposed construction unless other requirements are imposed or specific exceptions are permitted, in accordance with provisions of this section, 401–General.

2. When proposed additions and alterations are involved, the new work shall comply with applicable Minimum Construction Requirements.

401–B. Application. *Continued.*

3. Existing construction shall comply with the stated "Objectives" contained in these Minimum Construction Requirements.

4. Since these requirements are essentially minimum, this Administration will recognize and give credit for all construction and equipment that exceed these requirements. The Chief Underwriter may require compliance with higher requirements than those contained herein.

401–C. Local Regulations.

1. Compliance with local regulations affecting construction, heating, plumbing, sanitation, electrical installations, and lot improvements will be required in all cases. The highest requirement, whether in the local regulations, these Minimum Construction Requirements, or the drawings and specifications, shall govern.

2. Compliance with local regulations which are obsolete or which for other reasons are not being enforced by local code authorities, or any local requirements which are intended merely as recommendations, is not mandatory unless the local office considers compliance therewith necessary to safeguard the security of the insured mortgage loan.

3. The Federal Housing Administration does not assume responsibility for determining compliance with local requirements.

401–D. Special Conditions. When special conditions exist or arise during construction, which necessitate additional precautions, the Chief Underwriter may require work in excess of these requirements.

401–E. Changes After Submission. No changes, except for acceptable minor variations, from the drawings and specifications of the dwelling upon which a commitment has been based, will be permitted without first obtaining written approval from the FHA field office. When the applicant desires to make changes in the exhibits subsequent to the submission of an application, except for acceptable minor variations, the approval of the local Federal Housing Administration office shall be requested by the mortgagee in writing prior to the execution of any changes in the construction. Request for approval of changes shall be accompanied by adequate information describing the proposed changes.

401–F. Materials and Equipment.

1. Materials and equipment used in the construction shall be used appropriately and shall be of a standard equal to good practice commensurate with the class of dwelling being erected.

2. When there is doubt concerning the acceptability of materials and equipment, the standards listed in Appendix C are for use as a guide in determining such acceptability.

3. Newly developed materials and equipment may be used when test data and service records are submitted which indicate durability, performance and appropriate use, provided their use is acceptable to the Chief Underwriter.

Void; See revised leaf which follows

401–G. Workmanship. Compliance with these Minimum Construction Requirements with regard to materials and methods of assembly and with drawings and specifications will not, in itself, assure acceptance of the construction. Of equal importance is good workmanship, the lack of which will be sufficient cause to refuse acceptance of the construction.

401–H. Conventional Methods of Construction. Construction methods, and service installations such as heating, described in these Requirements are those in general use in conventional construction. Other conventional methods not covered in these Requirements may be used when acceptable to the Chief Underwriter. Such methods must be structurally sound, durable, safe and efficient, and at least the equivalent of those described in these Requirements.

401–I. Special Methods of Construction. New or special methods of construction, not generally considered conventional, will be treated as special cases. After complete analysis which includes structural design, marketability, etc., rulings covering acceptable methods are issued to FHA insuring offices by the Underwriting Headquarters, Washington, D. C.

The data desired and procedure to be followed for determination of acceptability are described in Federal Housing Administration Circular, "Rulings on New Methods of Construction and Determination of Acceptability of Individual Materials", as currently effective. Copies of this Circular may be obtained at the FHA field office.

401–J. Final Acceptance. Before final acceptance of a property as security for an insured mortgage, all buildings shall be complete and ready for occupancy with all equipment installed, connected and in operating condition and all utility connections completed, and service available.

401–K. Common Services and Facilities. Two living units included under one mortgage may have common services such as water, sewer, gas and electricity, and common facilities such as laundry, storage and heating, except that recirculating warm air from one living unit to another is not acceptable.

INSULATION AND VAPOR BARRIERS

402–A. Insulation

1. The total hourly heat loss of a living unit in Btu shall not exceed 60 times the floor area in square feet.

2. The overall coefficient of heat transmission in Btu per hour per square foot per degree temperature difference from air inside to air outside ("U" factor) shall not exceed:

0.27 for exterior walls and partitions exposed to unheated spaces.
0.15 for ceilings exposed to unheated spaces.
0.20 for floors over unexcavated spaces, garages or porches.

Void; see revised leaf which follows

402–B. Vapor Barriers.

1. Many combinations of materials used in the exterior portion of wall or roof construction have a combined vapor resistance sufficient to form a more or less effective vapor trap so that, when low outside temperatures occur, condensation is likely to form at some point within the wall, ceiling or roof construction, unless a vapor barrier of considerably greater resistance has been provided on the warm side to resist the passage of water vapor from within the dwelling.
2. When conditions described in 1 above exist, an effective vapor barrier shall be installed as close as practicable to the warm (inside) surface of any exposed wall or ceiling exposed to an attic or roof. The vapor barrier shall be continuous with all joints tight and applied tightly against studs, joists, electrical outlet boxes, register boxes and framed openings.
3. The vapor resistance of the vapor barrier shall be greater than (at least three times) the total vapor resistance of all materials and construction on the exterior side of the vapor barrier including exterior painting. The effectiveness of the vapor barrier shall be not less than the limitation established in the test procedure under which it is tested.

EXCAVATION

403–A. Foundations.

1. Excavation for foundations shall extend to a level which will provide adequate bearing. In case of doubt regarding bearing capacity, tests may be required for this determination.
2. Excavation shall extend below prevailing frost line and not less than 3 feet below finished grade, except in that portion of the state south of north boundary line of Madison County, where a depth of 2′6″ will be acceptable. Excavation shall extend not less than 12″ below natural grade.
3. Bottom of footing trenches shall be level. Where steps are necessary the vertical step shall not exceed the horizontal distance between steps. Horizontal distance between steps shall be not less than 2 feet. See 406–D–2.
4. Earth backfilling shall be placed against foundation walls in not more than 1-foot layers, well tamped. Debris or frozen earth shall not be used for backfilling.
5. The earth in bottom of trenches shall be protected against freezing.

403–B. Basementless Spaces.

1. Ground level shall be at least 2 feet below bottom of floor joists.
2. Where the interior ground level is below outside finish grade, adequate precautionary measures shall be taken to assure positive drainage at all times.
3. Remove all debris, sod, tree stumps, and other organic materials and provide a smooth surface free of pockets.

ROUGH GRADING

404. See "Lot Improvement Requirements" Section 800.

MASONRY MATERIALS. *Masonry materials described below apply to all masonry and concrete work.*

405–A. Cement.

1. Cement for concrete shall be portland cement.
2. Cement for mortar shall be portland or masonry cement. See 406–C.

401–G. Workmanship. Compliance with these Minimum Construction Requirements with regard to materials and methods of assembly and with drawings and specifications will not, in itself, assure acceptance of the construction. Of equal importance is good workmanship, the lack of which will be sufficient cause to refuse acceptance of the construction.

401–H. Conventional Methods of Construction. Construction methods, and service installations such as heating, described in these Requirements are those in general use in conventional construction. Other conventional methods not covered in these Requirements may be used when acceptable to the Chief Underwriter. Such methods must be structurally sound, durable, safe and efficient, and at least the equivalent of those described in these Requirements.

401–I. Special Methods of Construction. New or special methods of construction, not generally considered conventional, will be treated as special cases. After complete analysis which includes structural design, marketability, etc., rulings covering acceptable methods are issued to FHA insuring offices by the Underwriting Headquarters, Washington, D. C.

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401–J. Final Acceptance. Before final acceptance of a property as security for an insured mortgage, all buildings shall be complete and ready for occupancy with all equipment installed, connected and in operating condition and all utility connections completed, and service available.

401–K. Common Services and Facilities. Two living units included under one mortgage may have common services such as water, sewer, gas and electricity, and common facilities such as laundry, storage and heating, except that recirculating warm air from one living unit to another is not acceptable.

INSULATION AND VAPOR BARRIERS

402–A. Insulation

1. The total hourly heat loss of a living unit in Btu shall not exceed 60 times the floor area in square feet.

2. The overall coefficient of heat transmission in Btu per hour per square foot per degree temperature difference from air inside to air outside ("U" factor) shall not exceed:

0.27 for exterior walls and partitions exposed to unheated spaces.
0.15 for ceilings exposed to unheated spaces.
0.20 for floors over unexcavated spaces, garages or porches.

402–B. Vapor Barriers.

1. Many combinations of materials used in the exterior portion of wall or roof construction have a combined vapor resistance sufficient to form

402–B. Vapor Barriers. *Continued.*

a more or less effective vapor trap so that, when low outside temperatures occur, condensation is likely to form at some point within the wall, ceiling or roof construction, unless a vapor barrier of considerably greater resistance has been provided on the warm side to resist the passage of water vapor from within the dwelling.

2. When conditions described in 1 above exist, an effective vapor barrier shall be installed as close as practicable to the warm (inside) surface of any exposed wall or ceiling exposed to an attic or roof. The vapor barrier shall be continuous with all joints tight and applied tightly against studs, joists, electrical outlet boxes, register boxes and framed openings.

3. The vapor resistance of the vapor barrier shall be greater than (at least three times) the total vapor resistance of all materials and construction on the exterior side of the vapor barrier including exterior painting. The effectiveness of the vapor barrier shall be not less than the limitation established in the test procedure under which it is tested.

EXCAVATION

403–A. Foundations.

1. Excavation for foundations shall extend to a level which will provide adequate bearing. In case of doubt regarding bearing capacity, tests may be required for this determination.

2. Excavation shall extend below prevailing frost line, minimum 3'-0" below finished grade except south of the north boundary line of Madison County, 2'-6", and south of north line of Franklin County 2'-0" will be acceptable. Minimum entire State 12" below natural grade.

3. Bottom of footing trenches shall be level. Where steps are necessary the vertical step shall not exceed the horizontal distance between steps. Horizontal distance between steps shall be not less than 2 feet. See 406–D–2.

4. Earth backfilling shall be placed against foundation walls in not more than 1-foot layers, well tamped. Debris or frozen earth shall not be used for backfilling.

5. The earth in bottom of trenches shall be protected against freezing.

403–B. Basementless Spaces.

1. Ground level shall be at least 2 feet below bottom of floor joists.

2. Where the interior ground level is below outside finish grade, adequate precautionary measures shall be taken to assure positive drainage at all times.

3. Remove all debris, sod, tree stumps, and other organic materials and provide a smooth surface free of pockets.

ROUGH GRADING

404. See "Lot Improvement Requirements," Section 800.

MASONRY MATERIALS.

Masonry materials described below apply to all masonry and concrete work.

405–A. Cement

1. Cement for concrete shall be portland cement.

2. Cement for mortar shall be portland or masonry cement. See 406–C.

Above portion in this style type revised Nov. 1947 - MPRs, 1 or 2 L. U. for State of Illinois.

405–B. Aggregate.

1. Fine aggregate for concrete: Natural sand or sand prepared from stone, gravel or other material acceptable to the Chief Underwriter.
2. Fine aggregate for mortar: Natural sand, clean and well graded.
3. Coarse aggregate for concrete: Crushed stone, gravel, or other materials acceptable to the Chief Underwriter.

405–C. Water. Free from injurious amounts of organic materials or other deleterious substances.

405–D. Lime.

1. Hydrated Lime.
2. Quick lime, thoroughly slaked.

405–E. Masonry Units.

1. *General.*
   a. All units shall be of good quality, sound and free from defects.
   b. All units exposed to the weather or proposed as a stucco base shall be hard and have low water absorptive quality.
2. Brick for backup work or for interior walls shall be medium or hard burned.
3. Fire brick and flue lining shall be free of cracks or other defects.
4. Clay tile used in the construction of walls supporting floor, ceiling or roof loads shall be load-bearing tile.
5. Concrete Block aggregate shall consist of sand, gravel, crushed stone, bituminous or anthracite cinders, burned clay or shale or blast furnace slag.

CONCRETE AND MASONRY

406–A. General.

1. *Support of Masonry.* All masonry including veneer shall be supported on masonry, concrete or steel. In no case shall the wood frame be used as support.
2. *Protection.*
   a. In hot weather, protect concrete and masonry work to prevent rapid drying.
   b. In cold weather, maintain the temperature of concrete and masonry work above freezing until thoroughly set.
3. *Loading.* Allow sufficient time for strength of concrete and masonry work to develop before subjecting to loads or traffic.
4. *Sill and Rafter Plate Anchoring.*
   a. Sills shall be anchored to poured concrete foundation walls and rafter plates shall be anchored to all concrete and masonry walls.
   b. Minimum diameter of bolts ½ inch.
   c. Bolts shall be embedded in masonry unit walls not less than 15 inches; in poured concrete, not less than 6 inches.
   d. Spacing shall not exceed 8 feet o. c.; at least two bolts in each piece.
   e. Washers. Install one standard nut and washer on each bolt.

f. In masonry unit walls, install plate approximately 3 inches square, at head of bolt, embedded in masonry joint.

5. *Porch Stringer Support.* Masonry or concrete supports for stringers of porch steps shall be provided. The top of support shall be above the adjoining earth.

406—B. Concrete Work.

1. *General.*

a. Materials. See 405.

b. Water content shall not exceed 7½ gallons of water per bag of cement.

c. Retempering of concrete will not be permitted.

d. Reinforced concrete work shall comply with the recommendations of the Building Regulations for Reinforced Concrete by the American Concrete Institute.

2. *Minimum Mix.*

a. Plain concrete.

(1) Foundation walls less than 8″ in thickness, 1 part portland cement, 2 parts sand, 4 parts coarse aggregate; or controlled or transit-mix concrete having minimum compressive strength at 28 day; 2,000 lbs. per square inch.

(2) All other plain concrete, one part portland cement, 3 parts sand, 5 parts coarse aggregate; or controlled or transmit-mix concrete having minimum compressive strength at 28 days; 1,500 lbs. per square inch.

b. Reinforced concrete.

(1) Where slab thickness in concrete joist and slab construction is 3″ or less, concrete shall have a minimum compressive strength at 28 days of 2,500 lbs. per square inch.

(2) All other reinforced concrete, one part portland cement, 2 parts sand, 4 parts coarse aggregate; or controlled or tranit-mix concrete having minimum compressive strength at 28 days, 2,000 lbs. per square inch.

3. *Reinforcing.* Reinforcing shall be new billet steel bars, rail steel bars, welded wire fabric or cold drawn wire.

4. *Forms.*

a. Double forms shall be used for all concrete foundation walls.

Note: Where favorable soil conditions occur, exterior form may be omitted if acceptable to the Chief Underwriter.

b. Side forms shall be used for footings where soil conditions prevent sharp-cut trenches.

c. Build forms tight, straight, plumb, and brace rigidly.

d. Do not remove forms until concrete has thoroughly set.

e. Remove all forms and stakes before backfilling.

5. *Placing Concrete.*

a. Pour concrete continuously whenever possible and keep practically level throughout the length being poured.

b. When concrete is not poured continuously, clean, score and wet the top surface before continuing. Key all vertical joints.

c. Spade and rod concrete thoroughly in forms.

406–C. Masonry Work.

1. *Mortar.* Mix shall be as follows for the uses indicated in 2 below:

a. Portland cement mortar: 1 part portland cement, 3 parts sand by volume and lime not exceeding 25 percent of the cement by volume.

b. Cement-lime mortar: 1 part portland cement, 1 part lime and not more than 6 parts sand by volume.

c. Masonry cement mortar: 1 part Type II masonry cement and not more than 3 parts sand by volume. No other material except water shall be added to this mixture. Each bag of masonry cement shall bear the printed statement: "This cement complies with Federal Specification SS–C–181b, Type II masonry cement."

2. *Mortar Uses.*

a. Mortar for masonry below grade: For all walls, use mix 1–a. If dampproofed, mix 1—b, or c. may be used.

b. Mortar for masonry above grade: For all walls, use mix 1–a, b, or c.

c. Use of retempered mortar is not acceptable.

3. *Joints.*

a. Maximum thickness, ¾ inch.

b. Solid masonry units: fill joints solid.

c. Hollow masonry units: no through mortar joints.

d. Point all joints solid, both sides of wall. Outside and exposed inside joints shall be weathered or tooled unless otherwise acceptable to Chief Underwriter.

4. *Bonding.*

a. Brick masonry shall be bonded with not less than one through header in every 240 square inches.

b. Rubble stone masonry shall be bonded with bond stones evenly distributed, at least 4 inches thicker than other stones; minimum 20 percent of wall area. Vertical joints shall be staggered.

c. Intersecting concrete or masonry walls shall be bonded or anchored together in an acceptable manner.

d. Closed cell units or solid masonry shall be used at rough openings, corners and wall intersections. Filling exposed ends of cells is not acceptable.

406–D. Footings.

1. *General:*

a. Design for proper distribution of superimposed loads.

b. Material: Poured concrete.

c. Bear on solid, unfilled ground.

d. Reinforce with steel bars where footings cross or bear on filled trenches or other unstable soil.

e. Footing dimensions listed below are based upon soils of average bearing capacity (4,000 pounds per square foot). For soils of lesser bearing capacity or where unusual loading conditions exist, larger footings will be required. Detail shall be examined and approved by local FHA office before footings are poured.

2. *Wall Footings:*

a. Minimum dimensions for spread footings as listed in table A.

TABLE A

Number of stories and type of construction	*Thickness of footing (inches)*	*Project each side of wall (inches)*
One-story:		
Without basement:		
Frame	6	3
Masonry veneer on frame	6	3
Masonry	8	4
With basement:		
Frame	8	4
Masonry veneer on frame	8	4
Masonry	8	4
Over one-story with or without basement:		
Frame	8	4
Masonry veneer on frame	8	4
Masonry	12	6

b. Footings for one-story dwellings need have no projection on either side of masonry unit foundation walls when foundation walls are not less than:

(1) 12 inches thick supporting wood frame construction without basement.

(2) 18 inches thick supporting masonry veneered wood frame or solid masonry construction.

c. Footings need have no projection on either side of masonry unit foundation walls 8 inches or more in thickness supporting uncovered porches, steps and terraces; minimum footing thickness, 6 inches.

d. Omission of footings permitted under conditions of (b) when foundation walls are constructed of poured concrete.

e. Omission of footings for one-story frame dwellings containing no basement permitted provided the foundation walls are of poured concrete with bottoms splayed equally on each side to provide the same width of bearing surface as called for in (b) above.

3. *Pier, Post and Column Footings:*

a. One-story dwellings: minimum area, 3 square feet; thickness, one and one-half the projection, minimum, 8 inches.

b. Dwellings over one-story: minimum area, 4 square feet; thickness, one and one-half the projection, minimum, 12 inches.

4. *Chimney Footings:*

a. One-story dwellings: minimum thickness, 8 inches; minimum projection each side, 4 inches.

b. Dwellings over one-story: minimum thickness, 12 inches; minimum projection each side, 6 inches.

c. Pour integral with wall footing when chimney occurs in outside wall or inside bearing wall.

5. *Stepped Footings.* Where variations in the elevations of the bottom of wall footings are necessary, as may occur in the case of hillside properties, the vertical connection between footings at the step shall be constructed of concrete 4 inches thick and the same width as the footing. The steps shall be poured continuous with the footings. See 403–A–3.

6. *Footing Drain Tile.*

a. May be required by Chief Underwriter when water and soil conditions warrant.

b. Protect top of joints with strips of building paper and cover tile with 12 inches gravel or other porous material.

c. Connect with tight-joint pipe or tile to sewer, or to other outlet acceptable to the Chief Underwriter.

406–E. Concrete Slabs on Ground.

1. *Construction.*

a. Bed under slabs shall be gravel, cinders, or crushed rock, minimum thickness 4 inches. Earth under slab bed shall be leveled and tamped.

b. Wire mesh reinforcing: when required, minimum weight 20 pounds per 100 square feet.

c. Bottom of slab shall be not lower than top of footing. Continue slab over footing projection to foundation wall. See detail 1.

2. *Cement Floor Finish.*

a. Finish with steel trowel.

b. Concrete slab shall have integral finish; or

c. Topping: minimum mix, 1 part portland cement, 3 parts sand; minimum thickness, 1 inch.

3. *Slabs on ground* used as a finish floor or as a base for other floor finish in habitable rooms:

a. Minimum thickness, 4 inches, reinforced. See 1–b above.

b. Membrane waterproofing shall be provided. Mop between layers and on top surface with hot tar or asphalt. Extend to exterior walls or beyond the limits of habitable rooms, and turn up to top of slab. See details 2 and 3.

c. A continuous waterproofed insulation strip at least ½ inch thick shall be installed between the exterior wall and the floor slab.

d. Thicken the slab under bearing partitions to not less than 10 inches. The width of the 10-inch-thick portion of the slab shall be not less than 16 inches and shall bear on firm, undisturbed soil. Install a continuous trowell cut, 2 inches deep, in the slab on the center line of the bearing partition. In lieu of trowel cut, a ¼″ x 2″ wood strip may be used. Thicken slabs under non-bearing partitions to not less than 8 inches deep. Extend the membrane waterproofing continuous under the thickened portions of slab.

Note: Linoleum shall not be used as a floor covering on concrete slab on fill.

4. *Basement floor slabs.* Minimum thickness, 4 inches. Slope finish floor slab to drain. Bottom of slab shall be not lower than top of footing. Continue slab over footing projection to foundation wall.

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406–E. Concrete Slabs on Ground. *Continued.*

5. *Garage floor slabs.*

a. Minimum thickness, 4 inches.

b. Extend slab at least 2 feet in front of garage door opening to form an apron; slope to driveway. See 7–c below.

6. *Terrace and porch floor slabs.*

a. Minimum thickness, 4 inches.

b. Metal flashing shall be installed between slabs and all wood construction. See 412–F.

c. Intersection of walls with slabs. Porch and terrace slabs and concrete or masonry steps shall be supported at the intersection by metal anchors; piers or corbels built integrally or bonded to the foundation walls; or a supporting ledge on the foundation wall.

d. If slab is not reinforced, provide continuous foundation wall on all sides, extending not less than 3 feet below grade.

7. *Driveways and Walks.*

a. Minimum slab thickness, 4 inches.

b. Expansion joints shall be provided at garage apron and at 30-foot intervals.

c. A trowell cut approximately half-way through the slab shall be made at approximately 4-foot intervals.

406–F. Foundation Walls.

1. *General.*

a. Material, see 405.

b. Walls supporting frame construction shall extend not less than 8 inches above adjoining outside finish grade and be exposed not less than 6 inches. See details 5 and 8.

c. Walls supporting masonry veneered wood frame, extend foundation so that the wood construction is not less than 6 inches above outside finish grade. See detail 7.

d. Walls of hollow masonry units shall be capped with minimum of 4 inches of solid masonry or poured concrete. If concrete is used, reinforce with wire mesh (expanded metal lath not acceptable). See 409–C.

e. Hollow masonry unit foundation walls supporting girders shall be capped under the girder with minimum of 6 inches in height of solid masonry or poured concrete.

f. Area walls shall be anchored or bonded to the foundation wall.

g. Chimney foundations shall start at level of lowest adjacent foundation wall footings.

h. If special or unforeseen soil conditions warrant, the Chief Underwriter may require either reinforcement or increased wall thickness.

2. *Minimum Thickness.*

a. General. Not less than that of wall supported, except that foundation walls supporting one-story brick veneer wood frame walls may be 8

inches thick provided wall construction does not project beyond exterior face of foundation walls and wood studs bear on 2-inch plate resting on top of floor joists.

b. Poured Concrete Foundation Walls.

(1) 6 inches, minimum for walls supporting wood frame structures less than two stories high. See 406–B.

(2) 8 inches, minimum, for all other poured concrete walls.

c. Masonry Unit Foundation Walls.

(1) Masonry unit walls when not more than 7 feet below grade and when total height of foundation wall and wall supported does not exceed 30 feet at eaves and 35 feet at ridge in gable ends: minimum thickness, 8 inches. When exceeding these conditions: 12 inches, minimum.

(2) Flat-bed, square edge stone walls: 12 inches, minimum.

(3) Rubble stone walls: 16 inches, minimum.

3. *Pilasters.*

a. Concrete Walls. Pilasters shall be provided where girders frame into 6-inch poured concrete walls. Minimum size of pilaster, 2″ x 12″ poured integrally with wall. Locate girder to center on pilaster.

b. Masonry walls. Pilasters shall be provided where girders, whose clear span exceeds 12 feet, frame into 8-inch masonry walls of dwellings two or more stories in height: minimum size, 4″ x 12″ built integrally with wall. Locate girder to center on pilaster.

c. Walls in excess of 24 feet in length to be supported laterally by means of adequate pilasters or buttresses built integrally with wall.

4. *Girder pockets.* Provide 4-inch end bearing for girder on main wall.

406–G. Dampproofing and Waterproofing.

1. A dry basement shall be provided. Walls and floors shall be made watertight before final acceptance.

2. Basement and cellar walls shall be dampproofed as follows on exterior from finish grade to outside edge of footing, forming a cove at the intersection of wall with footing:

a. Masonry unit walls: apply ½-inch thick portland cement plaster coat over which apply at least one heavy coat of undiluted hot tar, hot asphalt or compound acceptable to Chief Underwriter.

b. Poured concrete walls: apply at least one heavy coat of undiluted hot tar, hot asphalt, or compound acceptable to Chief Underwriter.

Note: In certain site locations, where water conditions are known to offer no problem, the Chief Underwriter may permit the omission of G–2 above.

406–G. Dampproofing and Waterproofing. *Continued.*

3. Other methods of dampproofing and waterproofing may be used subject to the acceptance of the Chief Underwriter.

4. Footing drain tile shall be installed where required. See 406–D–6.

5. For dampproofing walls above grade, see 417–A–6.

406–H. Piers.

1. *Piers supporting exterior frame walls.*
   a. May be used for one-story frame dwelling only.
   b. Provide curtain walls, 3¾ inches minimum thickness, between piers and supported on concrete footings poured integrally with pier footings. Provide adequate girders for support of floor and wall loads between piers.

2. *Materials.* Shall be masonry or poured concrete except as noted in H–8 below.

3. *Minimum pier sizes.*
   a. Masonry: 8″ x 16″ or 12″ x 12″.
   b. Poured concrete: 10″ x 10″ or 12-inch round.

4. *Maximum pier spacing.*
   a. Exterior wall piers supporting floor joists: 8 feet o. c.
   b. Exterior wall piers in line parallel to joists and interior piers: 12 feet o. c.

5. *Exterior wall piers.* Maximum height above grade four times least dimension, except when supported laterally by masonry or concrete curtain walls.

6. *Minimum pier height above grade.* 8 inches.

7. When of hollow masonry units, cap with at least 6 inches solid masonry or concrete.

8. Concrete bases extending not less than 8 inches above finish grade shall be provided for support of wood posts supporting floors of frame porches.

406–I. Exterior Masonry Walls.

1. *Materials.* Masonry or poured concrete.

2. *Minimium thickness.* 8 inches.

3. *Maximum height for 8-inch thickness.* 30 feet from footing to eaves; or 35 feet from footing to ridge in gable ends.

4. *Backing.* When used, shall be solid or hollow masonry units, and shall have minimum thickness of:

a. 4 inches, when bonded to facing material as provided in 406–C–4.

b. 8 inches, when tied to facing material with corrugated metal ties.

5. *Furring* of not less than 1-inch thick wood strips shall be installed on exterior masonry walls less than 12 inches thick. In addition to vertical stripping; install horizontal strips at subfloor and ceiling. Spacing as permitted for interior finish, see 414. Bituminous waterproofing material applied directly to masonry is not acceptable for plaster base.

6. *Lintels* supporting masonry over openings shall be steel or reinforced concrete; or masonry arches shall be installed. Lintels shall have minimum of 4 inches bearing upon solid masonry or concrete at least 4 inches thick.

7. *Girders and beams* shall have minimum of 4 inches bearing on solid masonry or concrete at least 6 inches in height and of sufficient area to distribute the load.

8. *Floor Joists* shall have bearing on solid masonry not less than 4″ thick.

9. *Chases and Recesses.*

a. Construct at time wall is built.

b. Back and sides of chases and recesses in exterior walls shall be plastered. Radiator recesses shall also be insulated.

c. Recesses:

(1) Maximum depth: 4 inches.

(2) Maximum width, 30 inches; height 24 inches. However, when recesses occur under windows, recess may be full width of window and height may extend to window sill.

(3) Provide steel or concrete lintel to support masonry directly over recesses which exceed one foot in width.

d. Pipe Chases:

(1) Maximum depth, 4 inches.

(2) Maximum width, 12 inches.

(3) Maximum length of vertical chase in an 8-inch wall, 4 feet. Horizontal and diagonal chases are not acceptable.

10. Fur masonry walls under sinks and elsewhere as required to enclose horizontal pipes.

406–J. Masonry Veneer.

1. *Minimum thickness.*

a. Brick, 3¾ inches.

b. Ashlar stone masonry: dwellings less than 2 stories high, 3 inches; 2-story dwellings, 4 inches.

c. Rubble stone masonry: uncoursed (field stone), 12 inches; mosaic or random, 12 inches; coursed, dwellings less than 2 stories high, 8 inches; 2-story dwellings, 12 inches.

d. Lesser thicknesses may be used when acceptable to the Chief Underwriter.

406–J. Masonry Veneer. *Continued.*

2. *Masonry veneered wood frame construction.* Veneer applied over sheathing with air space between. See details 6 and 7.

a. Air space: provide 1 inch air space between masonry veneer and sheathing.

b. Base flashing: light weight roll roofing or waterproofed building paper shall extend over top of foundation wall from outside face of wall and not less than 12 inches up on sheathing.

c. Water-resistant building paper or saturated asphalt felt shall be applied over sheathing. Overlap base flashing at least 4 inches.

d. Bonding: Corrosion-resisting metal ties spaced not more than 15 inches vertically and 32 inches o. c. horizontally. When other than wood board sheathing is used, secure ties through to studs.

e. Weepholes, approximately 8 feet o. c., shall be provided by omitting the mortar in vertical joints at bottom course of veneer.

f. Other methods may be used subject to the acceptance of the Chief Underwriter.

406–K. Interior Masonry Walls.

1. *Material.* Masonry or poured concrete.

2. *Pipe recesses.* Construct at time walls are built.

3. *Party or lot line walls.*

a. Minimum thickness: poured concrete, 6 inches; masonry units, 8 inches.

b. Height above flat roofs, 2 feet. Cap with stone, corrosion-resisting sheet metal, portland cement mortar, or terra cotta coping.

c. Under pitched roofs: build masonry solid to underside of roof sheathing or to within 2 inches of sheathing and fill space with incombustible insulating material.

d. Not less than 4 inches of masonry shall separate all wood framing members framing into the wall.

e. Through openings are not permitted in party walls.

4. *Bearing partitions.*

a. Minimum thickness: poured concrete, 6 inches; masonry units, when supporting not more than one floor and ceiling joists which carry no load, 6 inches; otherwise, 8 inches.

b. Sections of walls 2 feet or less in length, such as occur at openings shall be constructed of solid masonry units or hollow units filled with concrete.

c. Lintels shall be steel, reinforced concrete, stone or masonry arches. Minimum 4-inch bearing shall be provided by solid masonry at least 4 inches thick.

d. Joists shall bear on solid masonry at least 4 inches thick.

e. Girders shall bear on solid masonry or concrete at least 6 inches thick.

5. *Nonbearing partitions.*

a. Minimum thickness, 3 inches.

b. Lintels shall be steel, reinforced concrete, masonry arches, or reinforced structural clay tile.

406–L. Masonry Chimneys. See details 48, 49, 50 and 51.

1. *Masonry chimneys* shall be constructed gas-tight and shall bear on masonry or concrete foundations.

2. *Material,* solid masonry units, 3¾ inches minimum thickness; footing shall be poured concrete; flue lining shall be fireclay or other material acceptable to the Chief Underwriter.

3. *Effective flue area for fireplaces:* not less than $\frac{1}{10}$ of fire place opening. Separate flues required for each fireplace.

4. For size and height of chimneys, see 503.

5. *Flue Linings.*

a. Fire clay flue lining supported on masonry or concrete shall be installed in all chimneys from a point below the breeching to top of chimney. For exception see L–8 below.

b. Two flues may be grouped without withes provided joints of linings are staggered.

c. Withes separating flues or groups of flues, 3¾ inches thick.

6. *Chimney cap* shall be provided to form wash from flue to outside edge of chimney, minimum thickness at outside edge, 2 inches.

7. *Thimbles are required.* Thimbles and clean-out doors shall be built in at the time chimney is constructed.

8. *Condensation.* When gas is used as fuel, provide flue lining of metal or composition acceptable to Chief Underwriter, or fireclay lining with joints made with portland cement mortar, or glazed tile lining bell and spigot type, bell end up. Provide drain to dispose of condensation.

406–M. Fireplaces. See details 49, 50 and 51.

1. *Smoke chamber and damper* shall be installed in all fireplaces.

2. *Ash dump,* when provided, shall empty into concrete or masonry chamber provided with metal clean-out door.

3. *Lining* shall be fire brick or other material acceptable to Chief Underwriter. Back lining with at least 8 inches of solid masonry.

4. *Hearth.*

a. Support on masonry or concrete.

b. Projection from chimney breast, at least 16 inches.

c. Width: at least 16 inches wider than fireplace opening.

STRUCTURAL STEEL AND IRON

407–A. General. Design, fabrication, and erection of structural steel shall comply with the recommendations of the American Institute of Steel Construction.

407–B. Beams and Girders.

1. *Connections.*
   a. Design to carry superimposed loads.
   b. Connections shall be riveted, bolted, or welded.

2. *Bearing* on walls shall be not less than 4 inches. Bearing on wood construction not acceptable.

3. *Bearing plates.*
   a. Design to distribute load, minimum thickness, $\frac{5}{16}$ inch.
   b. Bed in portland cement mortar.
   c. Plates may be omitted where flange provide adequate bearing.

4. *Reflection.* Not to exceed 1/360 of span.

407–C. Columns. See detail 11.

1. *Material.*
   a. Standard shape, steel or cast iron.
   b. Concrete-filled steel pipe, new material, standard weight or heavier.
   c. Standard steel pipe. Boiler tubing is not acceptable.

2. *Bases and caps.* Steel or cast iron.
   a. Caps shall be riveted or bolted to steel girders; spike or lag-screw to wood girders.
   b. Bases shall be anchored by bolts or embedded in concrete.

3. *Shims* shall be metal. Loose shims not acceptable.

WOOD CONSTRUCTION

408–A. Lumber.

1. *Softwood framing and board lumber* shall comply with American Lumber Standards and with grading requirements of the Association recognized in the trade as covering the species and under whose grading rules it was produced.

2. *Framing Lumber.* All species of softwood framing lumber are acceptable subject to the maximum allowable spans for the particular species, grade, and use. See Appendix A. Allowable spans for species of framing lumber not listed in Appendix A may be obtained from the Chief Underwriter.

3. *Board lumber* for subflooring, sheathing, and similar uses.

a. No. 3 Common or better for Douglas Fir, Sitka Spruce, Southern Cypress, West Coast Hemlock, California Redwood, Cedar, Eastern Hemlock, Tamarack, and Southern Yellow Pine.

b. No. 4 Common or better for White Fir, Western Larch, Spruce (except Sitka), Ponderosa Pine, Sugar Pine, Idaho White Pine, Northern White Pine, and Norway Pine.

4. All lumber shall be well seasoned. Lumber 2 inches thick and less shall have moisture content not to exceed 19 percent at the time dwelling is enclosed.

5. *Lumber dimensions.*

a. Nominal sizes are given in these requirements unless noted otherwise.

b. Minimum finish dimensions, in inches, shall comply with American Lumber Standards which are as follows:

Nominal	*Actual*	*Nominal*	*Actual*	*Nominal*	*Actual*
1	$^{25}/_{32}$	4	3⅝	8	7½
2	1⅝	5	4⅝	10	9½
3	2⅝	6	5⅝	12	11½

These dimensions apply to all widths and all thicknesses.

408–B. Framing—General.

1. *Structural framing members.*

a. Splicing between bearing points is not acceptable.

b. When structural strength is impaired by cutting, drilling, or by inherent defects, members shall be replaced or reinforced in a manner acceptable to the Chief Underwriter.

c. Provide framing for any unusual loading conditions which require special consideration; such framing subject to the acceptance of the Chief Underwriter.

2. *Framing at chimneys.* See details 48, 50 and 51.

a. Bearing of framing members on chimney masonry is not acceptable. Piers built integral with chimney may be used.

b. Framing members shall be not closer than 2 inches to chimney masonry. Fill 2-inch space with incombustible insulating material.

c. For chimneys other than masonry, provide clearances according to requirements in Underwriters Laboratories Approval Report.

3. *Firestopping.*

a. Partitions, outside stud walls and furring space of masonry walls shall be firestopped at first floor and at attic.

b. Wood blocks or masonry, tightly fitted, or other method acceptable to Chief Underwriter, may be used.

c. Provide stop between joists directly below and parallel to sole plate of dwarf partitions, so that joist space is completely sealed.

408–B. Framing—General. *Continued.*

4. *Recommended Nailing Schedule.* Nailing of joints in framing according to the following schedule using common or smooth box nails is acceptable:

Joist to sill or girder, toe nail	3–16d
Bridging to joist, toe nail each end	2–8d
1 x 6-inch subfloor to joist, face nail	2–8d
1 x 8-inch subfloor to joist, face nail	3–8d
2-inch subfloor to joist or girder	2–20d
Sole plate to joist or blocking	20d–16″ o. c.
Top plate to stud, end nail	2–16d
Stud to sole plate, toe nail	3–16d
Doubled studs	16d–30″ o. c.
Top plates, spike together	16d–24″ o. c.
laps and intersections	3–16d
Ceiling joists, to plate, toe nail	2–16d
laps over partitions	3–16d
to parallel alternate rafters	3–16d
Rafter to plate	3–16d
1-inch brace to each stud and plate	2–8d
1 x 8-inch sheathing or less, to bearing	2–8d
Over 1 x 8-inch sheathing, to bearing	3–8d
Corner studs and angles	16d–30″ o. c.

Other joints, nail to provide proportionate strength.

408–C. Floor Framing.

1. *Columns and posts.*

a. Structural steel or iron. See 407.

b. Wood posts in basement shall bear on concrete base resting on footing; top of base shall be 3 inches above finish floor; securely fasten top of post to girder. If necessary for full bearing, install bearing plate or cap secured to both post and girder.

c. Posts shall be squared at both ends. Minimum size: basement, 6 x 6 inches; above basement, 4 x 4 inches; above basement and supporting wood porch floors, 4 x 4 inches. See 406–H–8.

2. *Girders.*

a. Material: structural steel, reinforced concrete, solid wood, or built-up wood.

b. Spans for wood girders shall be determined in accordance with sound engineering practice and subject to acceptance of Chief Underwriter.

c. Joints of solid and built-up wood girders shall be made over pier or column supports only. See detail 11.

3. *Floor Joists.*

a. Spans for wood floor joists shall not exceed those tabulated in span tables in Appendix A.

b. Maximum joist spacing is limited by the direction of the finish flooring, the type of subflooring and ceiling material on underside. For single thickness flooring, maximum spacing, 16 inches o. c.

c. Framing into headers or side of wood girders. See details 13 and 15. Use steel angles 3″ x 3″, 18 ga. 7″ long, applied on sides of joists, or use steel joist hangers, or wood bearing strip, at least 2″ x 3″. Joists shall not be notched more than ¼ of joist depth.

d. Framing into side of steel girders. See detail 12. ½-inch clearance shall be allowed over top of top flange. Secure to girder or to opposite joists. Notch for bearing shall be not more than ¼ of joist depth.

e. Framing into masonry. See detail 14.

(1) Minimum joist bearing, 3 inches.

(2) Ends of joists shall have 2-inch fire cut or bevel.

(3) All floor joists except first floor joists framing into masonry walls: Anchor end of each fourth joist to masonry with metal straps (T-anchors) applied near bottom of joists.

(4) All joists except first floor joists parallel with masonry shall be tied to masonry with metal straps spaced not more than 8 feet o. c. extending over and secured to at least 3 joists.

f. Framing over girders and bearing partitions. See details 16 and 18. Ends of joists shall be lapped and spiked together or butted over center of bearing. When butted, tie with metal straps (⅛″ x 1″ x 18″ minimum), or 1-inch thick wood ties at least 2 feet long. Nail joists to bearing.

g. Double joists.

(1) Joists shall be doubled under all bearing partitions and under plaster finished nonbearing partitions when parallel to floor joists. Provide additional joists as required to support unusual loads, subject to approval of Chief Underwriter.

(2) Where double joists are separated to permit the installation of piping or duct work, provide 2-inch blocking full depth of joists at 4-foot intervals.

(3) Install double joists directly under front edge of bath tub where joists run parallel to tub.

h. Headers and trimmers.

(1) Headers receiving more than 4 tail beams shall be supported by two 3″ x 3″ steel angles applied one on each side of header and secured to the trimmer, by steel joist hangers or by wood posts. Headers 4 feet or less in length may be single and shall be supported as above or by wood bearing strips or other support acceptable to the Chief Underwriter.

(2) When openings occur at end of joist span and header is 4 feet or less in length, trimmers may be single.

(3) Double framing shall be used under all other conditions.

i. Cutting of floor joists. See detail 17.

(1) Notching top or bottom of joists not more than ⅙ joist depth for piping and duct work is permitted in end third of span only; otherwise header shall be installed.

(2) Holes may be bored through joists, maximum diameter 2½ inches; edges not nearer than 2 inches to top and bottom of joists.

j. Cross-bridging.

(1) Maximum spacing, 8 feet; minimum size, 1″ x 3″; double-nail at each end.

(2) Rigid metal bridging may be used when acceptable to Chief Underwriter.

k. Cantilevered construction: Detail drawings shall be submitted. See details 19 and 20.

4. *Subflooring* shall be installed on first floor in all cases.

a. Wood boards.

(1) Thickness, 1 inch; maximum width 10 inches.

(2) Subfloor boards shall be square edge. Ends of boards shall be cut parallel to and over center of joists.

(3) Maximum joist spacing: 16 inches o. c. when finish flooring is parallel to joists; 24 inches o. c. when finish flooring at least $^{25}/_{32}$″ thick is at right angles to joists.

(4) Nailing: Boards shall be double-nailed at each bearing, except 8- and 10-inch boards which shall be triple-nailed.

(5) Install blocking between ends of joists at wall for nailing ends of diagonal subfloor boards.

(6) Clearance: provide ½-inch clearance between subfloor and all masonry walls and partitions.

b. Plywood.

(1) Minimum thickness, ⅝-inch, 5 ply.

(2) Maximum joist spacing: 24 inches o. c. when direction of finish flooring *and* grain of outer plys of subflooring are at right angles to joists; 20 inches o. c. when one or the other but not both are at right angles to the joists.

c. At Chimneys. Lay plywood ½ inch clear of masonry.

d. Base for linoleum, composition, or rubber tile.

(1) T & G boards: minimum thickness ⅝-inch (finished); maximum width, 3 inches; sand or scrape smooth.

(2) Plywood: maximum joist spacing, 16 inches o. c.; minimum thickness, ⅝-inch, 5-ply; install solid blocking under all edges at right angles to floor joists; nail securely to joists and blocking; space nails 6 inches o. c. on edges and 10 inches o. c. on intermediate framing members. Plywood, when used over square edge board or plywood subflooring, minimum thickness ¼ inch.

e. Base for ceramic tile setting bed; provide 1-inch boards, maximum width, 8 inches. See 415–C. See details 36 and 37.

408–D. Ceiling Framing.

1. *Ceiling Joists.*

a. Ceiling joist spans shall not exceed those tabulated in tables, Appendix A.

(1) When access opening to attic does not exceed 400 square inches, use table entitled "No Attic Storage".

(2) When access opening exceeds 400 square inches, use table entitled "Limited Attic Storage". Minimum opening size, 24 x 36 inches.

(3) When a permanent or disappearing stair is provided, use table entitled "Floor Joists".

b. Use ceiling joists as ties for rafters whenever possible.

c. Framing of ceiling joists over girders and bearing partitions as required for floor joists. See 408–C–3–f.

d. Bridging: Solid, 2 inches thick full depth of joists, staggered for end nailing. Joists 8 inches and over, 1″ x 3″ cross bridging or rigid metal bridging may be used; maximum spacing, 8 feet on center.

2. *Hung ceilings,* flat roof construction.

a. Ceiling joist parallel to roof joists: size, 2 x 4's same spacing as roof joists; hangers, 1 x 4's spaced not more than allowable span for ceiling joists with "No Attic Storage." See detail 34.

b. Ceiling joist at right angles to roof joists; size, 2 x 4's spaced not more than 24 inches o. c.; hangers, 2 x 2's spaced not more than allowable span for ceiling joists with "No Attic Storage," with not more than 3 hangers on any one roof joist. See detail 35.

408–E. Roof Framing.

1. *General.*

a. Headers and trimmers.

(1) Headers 4 feet or less in length may be single.

(2) When chimney is at ridge or eaves and header is 4 feet or less, trimmers may be single; double framing shall be installed under all other conditions.

(3) Double headers and rafters shall be installed at dormer windows which are not supported on partitions.

b. Wall plates for rafters and roof joists shall be anchored to masonry walls. See 406–A–4.

2. *Pitched roofs.*

a. Minimum slope. See 411–A–1.

b. Rafter spans shall not exceed those tabulated in tables, Appendix A.

c. Rafters shall be cut for level bearing and spiked to wall plate; provide tie for rafters to prevent thrust. No portion of heel of roof rafters shall project beyond inside edge of wall plate.

d. Collar beams. See detail 32.

(1) Minimum size, 1 x 6 inch or 2 x 4 inch; maximum spacing, 5 feet o. c.

(2) When collar beams are above the lower third of the rafters, and ties are not provided at the plate line, provision shall be made for tying the lower end of rafters to floor, ceiling or wall construction. If the collar beams serve as ceiling joists in such cases, they shall be of same thickness and spacing as rafters.

e. Ridge boards: Not required for simple gable roof where all rafters are opposite one another. All other types, use 2-inch member with depth not less than cut end of rafter.

f. Hip and valley rafters.

(1) Minimum thickness, 2 inches; minimum depth, not less than cut end of jack rafters. Design to carry the loads imposed.

(2) When jack rafters of one roof frame on sole plate on top of roof sheathing applied to full length rafters of adjoining roof, valley rafters may be omitted.

g. Crickets or chimney saddles shall be installed at upper side of all chimneys not in contact with ridge.

3. *Flat roofs.*

a. Roof joist spans shall not exceed those tabulated in tables, Appendix A.

b. Joists shall be cross-bridged. Minimum size, 1″ x 3″, maximum spacing, 8 feet o. c. Doublenail at each end.

c. Framing of roof joists over girders and bearing partitions shall be same as required for floor joists. See 408–C–3–f.

4. *Trussed roof construction.* Design of trusses and roof construction shall be subject to acceptance of the Chief Underwriter.

408–F. Exterior Wall and Bearing Partition Framing.

1. *Studs.*

a. Studs shall be continuous lengths without splicing.

b. Minimum size, 2″ x 4″. (4-inch thickness.)

c. Maximum spacing: for all two-story construction, 16 inches o. c.; for construction less than two stories, determined by the type of interior and exterior finish. Maximum in any case, 24 inches o. c. See 408H, 410, and 414.

d. Maximum length for balloon frame, 20 feet; notch studs at second floor to receive 1 x 4 ribbon; nail joists to studs.

2. *Corner construction.*

a. Corner posts shall be not less than three 2 x 4's set to receive interior finish. See details 25, 26 and 27.

b. Corners of rooms shall be framed to receive interior finish. See details 23 and 24.

3. *Corner bracing.* See details 21 and 22.

a. Braces shall be installed at all external corners. Use 1 x 4's let into outside face of studs, set at 45 degrees, in opposite directions from each corner; extending from bottom of sill to top of plate; corner braces may be omitted only when wood sheathing boards are applied diagonally.

b. Openings near corner: use knee braces extending from corner post to sill and to top plate; extend over at least 3 stud spaces.

c. Openings at corner: brace as in 3–a, set as near opening as possible.

4. *Sill construction.*

a. Sills on poured concrete foundation walls shall be anchored. See 406–A.

b. Sills and girders on top of foundation walls and piers shall be leveled and grouted with portland cement mortar; wood is not acceptable for permanent shims.

c. See details 6 through 10. Other methods may be used if detailed on drawings submitted with applications and acceptable to Chief Underwriter.

5. *Window and door openings.*

a. Inner stud on jambs shall extend in one piece from header to bearing and shall be nailed to outer stud. See details 21 and 22.

408–F. Exterior Wall and Bearing Partition Framing. *Continued.*

b. Headers for usual loading conditions:

Size	*Maximum Span*	
Two 2 x 4's on edge	3′–6″	
Two 2 x 6's on edge	4′–6″	Truss construction preferred. See detail 28.
Two 2 x 8's on edge	6′–0″	
Two 2 x 10's on edge	7′–6″	

c. Where headers support concentrated loads or are subjected to other unusual loading conditions, the header shall be specially designed.

6. *Plates.*

a. Top plates shall be two 2 x 4's. Lap at corners and intersecting partitions. When plates are cut for piping or duct work, install steel angles on each side of plate not less than 1½ x 1½ x ⅛-inch, to serve as plate ties and bearing for joists. Spike angles to joists and plates, using not less than three nails at each end.

Alternate method: solid full depth 2-inch header and metal tie, ½-inch, 12 gauge, with three heavy nails or screws at each end.

b. Sole plates shall be 2 inches minimum thickness; exterior wall studs may bear on the sill or on a sole plate on top of subfloor.

7. End studs of bearing partitions connecting to masonry walls shall be anchored with bolts or spikes.

8. Wood bearing partitions in cellars or basements are not acceptable.

9. Studs shall be continuous (balloon frame) when exterior is to have stucco finish.

408–G. Nonbearing Partition Framing.

1. *Studs.*

a. Studs shall be continuous lengths without splicing.

b. Maximum spacing shall be determined by type of interior finish (see 414) and in no case more than the following:

(1) Partitions 6 feet or over in unsupported length with openings:

Minimum size	*Maximum spacing*
2 x 4's (4-inch thickness)	16 inches o. c.

(2) Partitions less than 6 feet unsupported length with openings:

Minimum size	*Maximum spacing*
2 x 4's (2-inch thickness)	16 inches o. c.
2 x 3's (3-inch thickness)	16 inches o. c.
2 x 4's (4-inch thickness)	24 inches o. c.

(3) Partitions 6 feet or over in length without openings:

Minimum size	*Maximum spacing*
2 x 3's (3-inch thickness)	24 inches o. c.
2 x 4's (4-inch thickness)	24 inches o. c.

c. Corner of rooms shall be framed to receive interior finish. See details 23 and 24.

2. *Openings.* See detail 31.

a. In 2-inch thick partitions: inner stud on jambs, size 2″ x 2″, extend in one piece from header to bearing and nail to outer stud; or single frame

with 2″ x 6″ jambs continuous from top plate to sole plate with header notched 2 inches into each jamb.

b. In 3-inch and 4-inch thick partitions: single framing is permitted provided opening does not exceed 3 feet in width and header is secured by spiking through jamb studs.

c. Headers:

Opening width, 3 feet or less:
2-inch thick partition, one 2″ x 3″ on edge.
3-inch thick partition, one 2″ x 3″ flat.
4-inch thick partition, one 2″ x 4″ flat.

Opening width, over 3 feet:
2-inch thick partition, one 2″ x 3″ on edge.
3-inch thick partition, two 2″ x 3″ flat.
4-inch thick partition, two 2″ x 4″s.

3. Top and sole plates shall be 2 inches minimum thickness; lap top plate at outside walls and at bearing partitions.

4. When parallel to ceiling joists, a nailing member secured to joists by blocking shall be provided on top of plate for securing ceiling finish. See detail 29.

408–H. Wall Sheathing. *Wall sheathing shall be installed except when its omission is acceptable to the Chief Underwriter. See 402–A.*

1. *Wood boards.*

a. Minimum thickness, 1 inch ($^{25}/_{32}$); maximum width, 8 inches unless triple-nailed; maximum stud spacing, 24 inches o. c.

b. Break joints over center of studs unless end matched (T & G) boards are used; if end matched, no two adjoining boards shall break joints over same stud space and each board shall bear on at least two studs.

c. Application: when applied diagonally, boards shall extend at 45 degrees in opposite directions from each corner; apply horizontally under stucco finish.

2. *Plywood.*

a.

Minimum thickness	*Maximum stud spacing*
$^{5}/_{16}$ inch	16 inches
$^{3}/_{8}$ inch	24 inches

b. Types of finish which affect the minimum thickness of plywood used:

(1) Under wood shingles: if $^{5}/_{16}$-inch plywood is used, apply shingles over 1″ x 2″ nailing strips using copper or galvanized nails for attaching shingles. Nailing strips may be omitted if barbed nails are used for attaching the shingles.

(2) Under asbestos-cement shingles and siding: if $^{5}/_{16}$-inch thick plywood is used, apply siding or shingle material with barbed nails. Do not apply over wood nailing strips.

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408–H. Wall Sheathing. *Continued.*

3. *Fiber board.*

a.	*Minimum thickness*	*Maximum stud spacing*
	½-inch	16 inches
	¾-inch	24 inches

b. Under wood shingle siding: apply 1″ x 2″ nailing strips over sheathing, spaced according to shingle exposure. See detail 44.

c. Fiber board is not acceptable as a nailing base.

d. 1″ x 3″ nailing strips may be applied directly to the studs and underneath the sheathing, spaced according to shingle exposure, provided shingle material is applied with nails at least 2″ in length.

4. *Gypsum Board.*

a. Minimum thickness, ½-inch; maximum stud spacing, 16 inches.

b. Under wood shingle siding: apply 1″ x 2″ nailing strips over sheathing, spaced according to shingle exposure. See detail 44.

c. Gypsum board is not acceptable as a nailing base.

d. 1″ x 3″ nailing strips may be applied directly to the studs and underneath the sheathing, spaced according to shingle exposure, provided shingle material is applied with nails at least 2″ in length.

408–I. Sheathing Paper.

1. *Material.*

a. Water-resistant building paper.

b. Asphalt saturated felt.

NOTE: *Only material of low vapor resistance shall be used as sheathing paper. See 402*–B.

2. *Application.*

a. Apply shingle fashion, 4-inch lap; lap 4 inches on strips around openings.

b. Strips of sheathing paper, at least 6″ wide, shall be installed behind exterior trim of all exterior openings except as noted in 3 below.

c. Install over stud frame when sheathing is not used and over all types of sheathing except as noted in 3 below.

3. Sheathing paper may be omitted over gypsum board and fiber board sheathing which has been factory treated to render it water-resistant, except behind masonry veneer and stucco exterior finish, subject to the following conditions:

a. The gypsum and fiber board sheathing shall have been factory treated to render the board moisture-resistant. Each piece of gypsum board sheathing shall bear a printed statement that it is "Water-Repellent."

b. All edges of boards which are cut after treatment, as may be necessary on the job, namely, at corners and around openings, shall be caulked with elastic waterproof caulking material. In lieu of caulking material, strips of water-resistant building paper or asphalt saturated felt not less

than 18 inches in width applied shingle fashion may be used to protect joints at corners.

c. The bottom edge of the sheathing board at the head of openings shall be so located as to permit the head flashing to extend under the sheathing and to be turned up behind the sheathing. The joint between the sheathing board and the head flashing shall be caulked.

408–J. Roof Sheathing.

1. *Wood boards.*

a. Minimum thickness, 1 inch ($^{25}/_{32}$); maximum width, 8 inches; maximum rafter spacing, 24 inches o. c.

b. Break joints over center of rafters unless end-matched (T & G) boards are used; no two adjoining boards, if end-matched, shall break joints over same rafter space and each board shall bear on at least two rafters.

c. Application. Lay closed under any roof material except that under wood singles, 1″ x 3″ shingle lath spaced according to shingle exposure may be used instead of closed sheathing.

2. *Plywood.*

a. *Roofing Material*	*Rafters maximum spacing (inches)*	*Plywood minimum thickness (inches)*
Wood and asphalt shingles	16	$^5/_{16}$
	20	$^3/_8$
	24	$^1/_2$
Slate, tile and asbestos-cement	16	$^1/_2$
	20	$^1/_2$
	24	$^5/_8$
Flat roofs	16	$^3/_8$
	20	$^1/_2$
	24	$^5/_8$

b. Application. Apply grain of outer plys at right angles to rafters.

c. Under wood shingles: apply 1″ x 2″ nailing strips over plywood less than ½-inch thick, spaced according to shingle exposure.

d. Protection. Outer edges of plywood along eaves and rake of roof, and edges and faces within 6 inches of outer edges shall receive two heavy coats of white lead paint. Also protect outer edges with mouldings or sheet metal flashing. Flashing along eaves may be integral with gutters. If gutters are not installed, form the flashing to provide a drip. See detail 43.

408–K. Stairs and Steps.

1. *Treads* of main stairs shall be hardwood.

Void; see revised leaf which follows

408–K. Stairs and Steps. *Continued.*

2. *Stringers.* See details 41 and 42.
   a. Provide solid bearing at top and bottom.
   b. Effective depth of wood stringers—minimum, 3½ inches.
   c. Open basement stairs: minimum stringer thickness, 2 inches.
   d. Third stringer: install if treads are less than 1⅛ inches thick and stair is more than 2′-6″ wide.
   e. The stringers of stairs to basement shall not penetrate the concrete floor or topping. They shall bear upon the top of the floor slab or on a raised masonry or concrete base or on the bottom step constructed of concrete.
3. *Construction.* Method of stair assembly shall be acceptable to the Chief Underwriter.

408–L. Caulking.

1. Caulk around exterior openings in masonry or masonry veneer walls.
2. Caulk at intersections of wood and masonry except when flashed. Caulking is not required at tops of foundations. See 408–F for grout requirement.

408–M. Weather Stripping. All exterior doors above basement shall have metal weather-stripping and interlocking metal thresholds. All in-swinging wood casement windows shall have metal weather-stripping.

PROTECTION AGAINST TERMITES

409–A. Methods of Protection. Provide protection by one or more of the following means in localities where, in the opinion of the Chief Underwriter, protection is necessary. For clearances between any wood construction and ground level, see 403–B and 406–F–1.
1. Poured concrete foundations. See B below.
2. Masonry unit foundations capped with reinforced concrete. See C below.
3. Metal shields. See D below and 412–F.
4. Wood preservative treatment. See E below. *This method protects only the members treated.*

409–B. Poured Concrete Foundations. Poured concrete shall be of good quality to assure foundation walls which will be free from cracks, porous areas, and voids or portions that may in time disintegrate. See 405 and 406–B.

409–C. Reinforced Concrete Caps. See detail 10.

1. *Materials.*
   a. Concrete. See B above.
   b. Reinforcing: 2″ x 2″ wire mesh, minimum wire 14-gauge; expanded metal lath not acceptable.

408–K. Stairs and Steps. *Continued.*

2. *Stringers.* See details 41 and 42.
   a. Provide solid bearing at top and bottom.
   b. Effective depth of wood stringers—minimum, 3½ inches.
   c. Open basement stairs: minimum stringer thickness, 2 inches.
   d. Third stringer: install if treads are less than 1⅛ inches thick and stair is more than 2′-6″ wide.
   e. The stringers of stairs to basement shall not penetrate the concrete floor or topping. They shall bear upon the top of the floor slab or on a raised masonry or concrete base or on the bottom step constructed of concrete.
3. *Construction.* Method of stair assembly shall be acceptable to the Chief Underwriter.

408–L. Caulking.

1. Caulk around exterior openings in masonry or masonry veneer walls.
2. Caulk at intersections of wood and masonry except when flashed. Caulking is not required at tops of foundations. See 408–F for grout requirement.

408–M. Weather Stripping. All exterior doors above basement shall have metal weather-stripping and interlocking metal thresholds or shall have storm doors. All inswinging wood casement windows shall have metal weather-stripping.

PROTECTION AGAINST TERMITES

409–A. Methods of Protection. Provide protection by one or more of the following means in localities where, in the opinion of the Chief Underwriter, protection is necessary. For clearances between any wood construction and ground level, see 403–B and 406–F–1.
1. Poured concrete foundations. See B below.
2. Masonry unit foundations capped with reinforced concrete. See C below.
3. Metal shields. See D below and 412–F.
4. Wood preservative treatment. See E below. *This method protects only the members treated.*

409–B. Poured Concrete Foundations. Poured concrete shall be of good quality to assure foundation walls which will be free from cracks, porous areas, and voids or portions that may in time disintegrate. See 405 and 406–B.

409–C. Reinforced Concrete Caps. See detail 10.

1. *Materials.*
   a. Concrete. See B above.
   b. Reinforcing: 2″ x 2″ wire mesh, minimum wire 14-gauge; expanded metal lath not acceptable.

Above portion in this style type revised January 1948 - MPRs 1 or 2 L.U. for State of Illinois.

2. *Installation.*

a. Minimum thickness, 4 inches.

b. Pour continuous in one operation on top of all unit masonry foundation walls and piers; and under joists, sills and girders, unless shielded.

409–D. Metal Shields.

1. *Material,* minimum weight or gauge:

a. Copper, cornice temper, 12 ounce.

b. Galvanized sheet metal, 26 gauge, 1.25 ounce zinc coating (total both sides) per square foot.

c. Tin, 40 pound block tin coating, painted both sides.

d. Copper-coated building paper, minimum coating 3 ounce, for use only where no projection is required.

e. Special types of metal shields may be used provided acceptance is first obtained from the Chief Underwriter and installation is in accordance with manufacturer's recommendations.

2. *Installation.* See details 4 through 9.

a. Continuous on top of foundation walls under wood sills, and under end of wood girders and joists, and on top of piers.

b. Lock or solder seams entire length. Spot soldering not acceptable.

c. Caulk sill bolts or other penetrations with coal-tar pitch.

d. Bent or damaged shields shall be straightened or repaired.

e. For foundation walls in and enclosing basementless areas, including masonry or concrete walls separating basement from basementless spaces, extend shield through wall (at least 8 inches above finish grade) under wood construction.

f. Project 2 inches beyond inside face of foundations in basementless areas and turn down additional two inches on 45 degree angle. In basements, projection beyond face of wall may be reduced to ½ inch.

g. Projection outside foundations to extend down on angle to show ¼ inch below wood finish.

h. Wood posts in basements: install shield between post and base.

i. Untreated wood girders framed into masonry unit foundation walls below concrete cap: install continuous shields around and under ends of girders extending the shields 4 inches into the joint between the wall and concrete cap; shield shall extend at least to the inside face of the wall.

409–E. Wood Preservative Treatment.

1. *Acceptable methods of treatment.*

a. Full- or empty-cell pressure process. *Preferred method of treatment.*

b. Hot-and-cold bath process.

NOTE: *Brush coat, spraying, or dipping methods of treatment not acceptable when preservative treatment is mandatory.*

2. *Application.* Treat all lumber in contact with foundation walls or piers including girders, sills, floor joists, headers and firestoping.

409–F. Additional Protection.

1. Where pipes enter ground in basementless spaces, install conical metal shields caulked with coal-tar pitch. Minimum distance of pipe to wall, 4 inches; minimum distance of shield to wood construction, 4 inches.

2. All horizontal pipes in basementless spaces shall be at least 18 inches above ground.

3. Metal flashing shall be used between all woodwork and abutting masonry or concrete terraces or platforms. See 412–F.

4. In severely infested areas, the Chief Underwriter may require both shields and preservative treatment of lumber and may also impose special structural requirements.

EXTERIOR WALL FINISH

410–A. Wood Siding.

1. Grade shall be commensurate with quality and class of dwelling but in no case less than select grade. Species and grade shall be listed in FHA Form No. 2005 and in specifications for siding, using same term as in grading rules of producer's association.

2. Well seasoned material shall be used. Moisture content shall not exceed 12 percent.

3. *Bevel siding* (lapped).

a. Finish dimensions, except as in b below, shall be:

Nominal width in inches	*Thickness in inches*	
	at top	*at butt*
4, 6, & 8	3/16	7/16
10 and 12	3/16	11/16

b. When bevel siding is applied over fibre board sheathing with studs spaced 20 or 24 inches o. c., minimum finished thickness of siding shall be 1/4 inch at tip and 1 1/16 inch at butt. Maximum width of siding, 10 inches.

c. Minimum headlap: 1 inch for 4- and 6-inch width; 1 1/4 inches for widths over 6 inches.

d. Nail at each bearing with hot-dipped galvanized nails. Do not nail through board underneath.

4. *Rustic and drop siding.*

a. Minimum thickness, 3/4 inch (finished); maximum width, 8 inches (nominal).

b. Nail at each bearing with hot-dipped galvanized nails.

5. *Shiplap or matched siding* (flush).

a. Minimum thickness, $^{25}/_{32}$ inch (finished); maximum width, 12 inches (nominal).

b. Nail at each bearing with hot-dipped galvanized nails.

c. When boards are applied vertically, set edges in white lead.

410–B. Wood Shingle Siding.

1. *Shingle grades.*

a. Single course siding, No. 1 or No. 2.

b. Double course siding, No. 1 for exposed shingles; under course may be No. 1 or No. 2. "Undercourse Grade" may be used when acceptable to Chief Underwriter.

2. *Maximum exposure.*

Shingle Length (inches)	*Single Course Exposure (inches)*	*Double Course Exposure (inches)*
16	7½	12
18	8½	14
24	10	16

3. *Nailing.*

a. Nails shall be copper or hot-dipped galvanized.

b. Butt nail double coursing; exposed nails shall be small-headed.

410–C. Asbestos-Cement Siding and Shingles.

1. Apply over solid sheathing. Application over nailing strips is not acceptable.

2. Apply clapboards and shingles in accordance with manufacturer's recommendations.

3. Nails shall be noncorrodible.

410–D. Plywood.

1. *Grademark.* Each sheet shall be identified with the manufacturers official insignia indicating that the plywood is for exterior use.

2. Plywood, ¼-inch thick. If sheathing other than wood is used, install solid blocking between studding as provided in D–3 below.

410–D. Plywood. *Continued.*

3. *Installations.*

a. Protect edges prior to erection with paint, mixed 100 pounds white lead paste, 1¾ gallons raw linseed oil and 1 pint dryer, applied without thinning.

b. Vertical joints shall occur over studs.

c. Horizontal joints: install solid blocking between studding for nailing.

d. Butt joints of square-edge material, whether exposed or covered by battens, shall be filled with mastic.

e. Corner boards shall be applied over plywood or plywood shall be butted against intersecting boards at all corners.

f. Nails shall be hot-dipped galvanized, flat head. Maximum spacing, on edge, 6 inches o. c.; at intermediate bearings, 12 inches o. c.

410–E. Stucco. See 408–F–9.

1. *Lath for stucco.*

a. Expanded metal lath, zinc-coated or galvanized:

(1) with large openings, 1.8 pounds per square yard.

(2) with small openings, 3.4 pounds per square yard.

b. Woven wire fabric, galvanized after fabrication:

(1) 18-gauge wire, maximum mesh, 1 inch; or

(2) 17-gauge wire, maximum mesh, 1½ inch; or

(3) 16-gauge wire, maximum mesh, 2 inches.

c. Welded wire fabric, galvanized before welding:

(1) 16-gauge wire, 2″ x 2″ mesh with waterproof paper backing; or

(2) When applied over sheathing which has been covered with water-resistant building paper; 17-gauge wire, 2″ x 2″ mesh without paper backing; or 18-gauge wire, 1″ x 1″ mesh without paper backing.

d. Metal lath, mesh or fabric shall be held at least ⅜-inch away from sheathing. Galvanized furring nails, metal furring strips or self furring lath shall be used.

2. *Stucco Plaster.*

a. Mixture: 1 part portland cement, 3 parts sand, and hydrated lime equal to 10 percent of cement by volume; or prepared portland cement stucco used in accordance with manufacturer's recommendations.

b. Thickness: 3-coat work, 1 inch total; 2-coat work, ⅝ inch total.

c. Application:

(1) 3-coat work shall be used over wood frame.

(2) 2-coat work shall be used over masonry surfaces.

(3) Finish coat may be trowel coat of prepared exterior stucco.

(4) Thoroughly cover and embed lath in stucco.

(5) Keep wet three days after application of each coat.

(6) Drying time between coats, 3 days.

(7) Stucco shall not be applied when temperature is less than 40 degrees F.

(8) Stucco applied over wood lath is not acceptable.

410–F. Exterior Wood trim.

1. *General.* The species and grade of exterior wood trim shall be appropriate for the proposed use and this, together with workmanship in its installation, shall be of a quality suitable for the class of dwelling under consideration and shall be acceptable to the Chief Underwriter. Species and grade shall be listed in FHA Form No. 2005 and in specifications for exterior wood trim using same term as in grading rules of producer's association.
2. All exterior trim shall be thoroughly seasoned and kiln-dried, and sanded free of tool marks and other objectionable defects.
3. Moisture content at the time of installation shall not exceed 12%.
4. Set nails; and seal with putty after prime coat of paint has been applied.

ROOF COVERINGS

411–A. General.

1. *Roof slope.*

a. Shingle and tile roofs (except porches), 5 in 12 minimum.

b. Shingle and tile porch roofs, 3 in 12 minimum.

c. Built-up roofs (gravel or slag surface), 3 in 12 maximum.

d. Built-up roofs with mineral surface cap sheet, 3 in 12 maximum.

e. When materials and method of application provide precautions in excess of these minimum requirements to assure a weather-tight roof, above roof slopes may be reduced subject to acceptance by Chief Underwriter.

f. All shingle roofs shall have Boston hips and ridges.

2. Double starting row shall be used on all shingle applications.
3. Nails for attaching roof covering shall be copper or hot-dipped galvanized nails. Weight, length and size of head as recommended by manufacturer of roof covering.

411–B. Asphalt Shingles.

1. Fire Underwriters' Class C label shall appear on each bundle.
2. Approximate minimum weights per square (shipping weights):

a. Square butt strip 210 pounds.

b. Hexagonal strip 215 pounds.

c. Individual shingles 250 pounds.

411–B. Asphalt Shingles. *Continued.*

3. Exposure as required for Fire Underwriters' Class C label.

4. Headlap shall be as recommended by manufacturers;. minimum, 2 inches.

5. The roof covering after application shall provide at least double thickness at all points. Cutouts and spacings between shingles not in excess of ¾ inch may be disregarded in determining compliance with this requirement.

6. *Underlay.*

a. Asphalt-saturated felt: weight approximately 15 pounds per 100 square feet; or

b. Asphalt-saturated and coated building paper: weight approximately 10 pounds per 100 square feet.

c. Underlay may be omitted only on roof slopes of 7 in 12 inches or more when package containers are stamped by manufacturers showing approximate shipping weight of 210 pounds or more per square; or when triple thickness is obtained at all points.

411–C. Wood Shingles.

1. Shingles shall be edge grain, tapered shingles (No. 1 grade).

2. *Minimum size.*

Length (inches)	*Thickness*
16	5 butts in 2 inches
18	5 butts in 2¼ inches
24	4 butts in 2 inches

3. *Maximum exposure.*

Slope of roof		*Exposure for Shingle length (inches)*		
Rise	*Run*	*16*	*18*	*24*
Under 5	12	3¾	4¼	5¾
5 and over	12	5	5½	7½

4. *Underlay* is not required.

411–D. Asbestos Cement Shingles.

1. Quality. Dense, hard structure and thoroughly seasoned.

2. Fire Underwriters' Class A or B label shall appear on each bundle.

3. Underlay shall be one layer asphalt saturated felt, approximately 30 pounds per 100 square feet.

4. *American Method.*
   a. Standard shingle: minimum weight per square, 470 pounds.

Length of Shingle (inches)	*Maximum exposure (inches)*
16	7
15	6½
12	5

   b. Strip shingle: minimum weight per square, 250 pounds.

5. *Dutch Method.*
   a. Minimum weight per square, 265 pounds.
   b. Minimum head-lap, 3 inches.
   c. Minimum side lap, 4 inches.

6. *French or Hexagonal Method.*
   a. Minimum weight per square, 250 pounds.
   b. Minimum overlap 2 edges, 3 inches.

411–E. Tile Roofing.

1. Quality. Hard-burned roofing tile.

2. Underlay shall be approximately 30-lb. asphalt saturated felt.

3. Shingle tile, American method.

Length of Shingle (inches)	*Maximum exposure (inches)*
16	7
15	6½
14	6
12	5

4. Interlocking tile and curved tile: Lay in accordance with manufacturer's recommendations.

411–F. Slate Shingles.

1. Quality. Slate shall be free from knots or knurls and of reasonably smooth cleavage.

2. Underlay shall be approximately 30-lb. asphalt saturated felt.

3. *American Method.*
   a. Minimum thickness, 3/16-inch.

Length of shingle (inches)	*Maximum exposure (inches)*
18	7½
16	6½
14	5½
12	4½
10	3½

411–F. Slate Shingles. *Continued.*

4. *Special methods.* Slate shingles laid by other than American method may be used if acceptable to Chief Underwriter.

411–G. Built-up Roofs.

1. Asphalt and tar and gravel coverings, including flashings shall comply with requirements of Underwriters' Laboratories, Inc., Class B, minimum 3-ply.

2. Apply according to manufacturer's directions.

3. Each ply of felt: minimum weight, 14 pounds per 100 square feet.

4. Surface roofs with:
   a. Roofing gravel or crushed stone, weight approximately 400 pounds per 100 square feet; or
   b. Crushed slag, weight approximately 300 pounds per 100 square feet.

5. Top ply of felt and crushed stone or slag surfacing may be replaced with one layer of mineral surfaced cap sheet, minimum weight 85 pounds per square.

411–H. Metal Roofs.

1. *Materials.*
   a. Galvanized sheet metal: 26-gauge sheets, 1.25 ounce (total weight both sides) zinc coating per square foot.
   b. Copper: 16-ounce soft (roofing temper).
   c. Terneplate (roofing tin): IC or IX, 40-pound coating.

2. *Nails.*
   a. Hard copper or copper alloy shall be used for copper roofs.
   b. Hot dipped galvanized nails for galvanized sheet metal roofs.

3. *Seams and joints* shall be locked or soldered and made watertight.

411–I. Other Types of Roof Coverings. Roof coverings, such as metal shingles, may be used when the type and weight of material, and method of application are acceptable to the Chief Underwriter.

FLASHING

412–A. Materials.

1. Copper shall be 16 ounce soft (roofing temper).

2. Galvanized sheet metal shall be 26 gauge, 1.25 ounce (total weight both sides) zinc coating per square foot, painted both sides.

3. Lead: hard lead, 2 pounds; soft lead, 4 pounds.

4. Tin: 40-pound coating, painted both sides.
5. Other materials as provided for specific purposes in this section.

412–B. Openings.

1. *Heads of openings, wood frame walls.*
   a. Sheet metal shall extend behind finish siding material and be turned down over outside edge of drip cap; or
   b. Three ounce copper-coated building paper may be used provided flashing is not exposed to weather more than 2 inches. Extend flashing behind siding. Blind tack at outside edge of drip cap, 1 inch o. c.
   c. Extended bevel drip cap with top lug may be used. Lap siding down over drip cap lug, properly fitted to assure water tight joint.
2. *Heads and sills of openings, masonry-veneered wood frame walls.* See detail '45.
   a. Material: sheet metal or membrane waterproofing material acceptable to Chief Underwriter.
   b. Head flashing shall extend from front edge of lintel, up and over top of lintel and up on sheathing under building paper.
   c. Sill flashing shall extend under masonry sill, up on sheathing and under wood sill.
3. *Heads and sills of openings, masonry walls.* See detail 46.
   a. Material: sheet metal or membrane waterproofing material acceptable to Chief Underwriter.
   b. Head flashing shall extend from front edge of lintel, up and over top of lintel through wall and turn up 1 inch on inside surface.
   c. Sill flashing shall extend under and behind masonry sill.
4. *Heads of openings, stuccoed wood frame walls.*
   a. Material shall be sheet metal.
   b. Drip. Form drip on front edge of drip cap and extend flashing up behind building paper underneath stucco.

412–C. Intersections, Stucco and Other Materials. Use sheet metal flashing at all horizontal and vertical intersections.

412–D. Valleys.

1. *Rigid shingle roof covering.*
   a. Flash with sheet metal.
   b. Flashing on roofs of slopes less than 7 in 12, minimum width of flashing 18 inches; on roofs of slopes 7 in 12 or more, minimum width of flashing 12 inches.
2. *Asphalt shingle roof covering.*
   a. Flash with sheet metal; or
   b. Two thicknesses of mineral surfaced roll-roofing shall be used, cut from rolls weighing not less than 85 pounds per square. Bottom strip shall be not less than 12 inches wide; top strip, at least 18 inches wide. Single strip, 18 inches wide may be used under closed valleys.

412–E. Roof and Wall or Parapet Intersections. Intersections shall be flashed. If walls are of masonry or masonry veneer, sheet metal counterflashing shall be installed.

1. *Sloping roof.* Use sheet metal flashings.
2. *Flat roof.* Use sheet metal or same material as roof covering. When sheet metal is not used, install 45 degree cant strip at roof and wall intersection.

412–F. Terrace and Porch Slabs. Flash along all edges which abut wood construction to completely separate wood from masonry or concrete.

1. Flashing material shall be sheet metal.

2. Flashing shall extend from ½ inch beyond inside face of foundation wall, across top of foundation (beneath wood sill) to outside face of wall; turn flashing up behind exterior wall finish to a point 4 inches above top of slab; fold or turn flashing down at this point and extend to top of slab and thence out on slab (beneath exterior wall finish) projecting ¼ inch beyond the outside face of wall finish. See detail 9.

3. If termite protection (see 409) is by use of:

a. Termite shields. Soldered or locked seam connection shall be made between terrace or porch slab flashing and shields. Use same material for flashing as is used for shields.

b. Concrete capped masonry foundations or wood preservative treatment. The flashing shall cross through wall under cap or under top course of solid masonry.

c. Poured concrete foundation. The ends of the flashing shall be sealed in dense concrete or coal-tar pitch.

412–G. Chimneys. See detail 47.

1. All chimney and roof intersections shall be flashed and counterflashed with sheet metal flashings.
2. Provide cricket or saddle covered with sheet metal or when acceptable to Chief Underwriter, same material as roof covering. When other than sheet metal is used, the material shall be flashed and counterflashed at the chimney with sheet metal.

GUTTERS AND DOWNSPOUTS

413–A. Gutters and downspouts shall be installed on all roofs unless their omission is acceptable to the Chief Underwriter. When installed they shall be constructed with back edge not less than 1 inch higher than the front (outside) edge.

413–B. Materials.

1. *Copper.* 16 ounces, hard (cornice temper).

2. *Galvanized sheet metal* shall be 26 gauge, 1.25 ounce (total weight both sides) zinc coating per square foot, painted both sides.

3. *Solid wood gutters.* Paint inside with two coats pitch or three coats lead-in-oil paint after installation.

413–C. Basket Strainers.

1. Material shall be copper wire for copper gutters; heavily galvanized wire for all other gutters.

2. Install strainers in all gutter outlets to downspouts.

413–D. Roof Water Disposal.

1. Splash blocks at bottom of downspouts shall be constructed of concrete or other material acceptable to Chief Underwriter. Design to carry water at least 3 feet from building; or

2. Connect to sewer, or other outlet acceptable to Chief Underwriter. Make connection above grade.

3. Underground lines shall be located outside of foundation walls.

INTERIOR WALL AND CEILING FINISH

414–A. Lath and Plaster.

1. *Wood Lath.*
   a. Maximum stud spacing, 16 inches o. c.
   b. Lath, No. 1, $\frac{5}{16}$-inch thick.
   c. Space lath $\frac{1}{4}$ to $\frac{3}{8}$-inch apart. Break joints every seventh lath. Nail at each bearing.

2. *Expanded Metal Lath.*
   a. Painted or galvanized lath.
   b. Minimum weights: maximum spacing of supports.

Use	*Pounds per square yard*	*Stud or joist spacing (inches)*
Walls	2.5	16
	3.4 flat-rib	20
	4.0 flat-rib	24
	3.0 $\frac{3}{8}$″ rib	24
Ceilings	2.75 flat-rib	16
	3.4	16
	3.4 $\frac{3}{8}$ rib	24

3. *Woven Wire Fabric, Galvanized.* Minimum gauge; maximum mesh and spacing of supports.

Use	*Wire gauges*	*Mesh per inch*	*Stud or joist spacing (inches)*
Walls	19	2½	16
Ceilings	18	2½	16
	*18	2½	20

**With stiffeners.*

4. *Galvanized wire fabric.*

a. Use with paper backing. Paper, absorbent quality or perforated.

b. Minimum size of wire, 16 gauge; maximum mesh, 2″ x 2″; maximum spacing of supports, 16 inches o. c.; when used on ceilings, paper backing shall be combined integrally with wire fabric.

5. *Insulating fibre board lath.*

a. Minimum thickness, ½-inch.

b. Lath size, 18″ x 48″. Lath, 24″ x 48″, may be used provided all joints at right angles to the framing members are covered with continuous strips of metal lath and ends of lath are nailed to solid bearing (framing members) at approximately 4 inches o. c. including intermediate supports.

c. Maximum stud or joist spacing, 16 inches o. c.

d. Apply in accordance with manufacturer's directions.

6. *Gypsum board lath.*

a. Minimum thickness, ⅜-inch for maximum stud or joist spacing, 16 inches o. c., and ½-inch for stud or joist spacing 24″ o. c.

b. Size, 16″ x 48″.

c. Apply in accordance with manufacturer's directions.

7. *Lathing.*

a. At heads of openings, lath shall be installed so vertical joints of first course of lath above head will not occur on jamb studs. See detail 30.

b. Corner beads, galvanized, shall be installed on all external corners.

c. Cornerites of metal lath, or wire fabric shall be installed except where special clip systems are used for installing the lath and the manufacturers of such systems do not recommend cornerites.. Minimum width of cornerites, 5 inches, 2½ inches on each surface of internal angles.

d. Over solid wood surfaces, install metal lath on strips or use furring nails. Metal lath shall be lapped on adjoining lath surfaces.

8. *Plaster.*

a. Mix all plaster (lime and prepared) according to manufacturer's recommendations.

b. Quick (lump) lime, shall be thoroughly slaked.

c. Plaster shall be applied in three coat or two coat double-up work; minimum thickness, ½-inch over lath or masonry base. Finish all ceilings level and walls and corners, plumb and straight.

414–B. Ceramic Tile.

1. *Grade* shall be Standard Grade or better.

2. *Installation.*

a. Studs shall be covered with 15-pound asphalt saturated felt applied shingle style (unless metal lath is paper-backed).

b. Metal lath. See 414–A–2, 3 and 4.

c. Scratch coat: portland cement plaster, minimum 5/8-inch thick, integrally waterproofed. Scratch thoroughly. Allow to dry before installing tile.

d. Other methods of installation may be used when the type of base and manner of application are acceptable to the Chief Underwriter.

414–C. Bathroom Interior Finish.

1. *Materials.* Waterproof finish wall materials shall be installed in showers and over bathtub where showers occur. Materials which are acceptable to the Chief Underwriter may be used for finish in other locations in the bathroom.

2. *Installation.*

a. Install in accordance with manufacturer's instructions.

b. In showers: minimum height, 6 feet; over bathtubs where showers occur, minimum height above rim, 4 feet.

c. When applied surface materials are used, joints at corners, bathtub, top edge of wainscot and at intersections of wainscot and other materials shall be caulked and protected. Moldings designed for the purpose or other materials satisfactory to the Chief Underwriter may be used.

414–D. Dry Wall Finish.

1. *Minimum thickness.*

Type of Finish	*Spacing of framing members (inches)*		
	16	*20*	*24*
Plywood	1/4	1/4*	3/8
Gypsum board	3/8	1/2	1/2*
Fiber board	1/2	3/4	3/4

**Apply long dimension at right angles to framing members.*

2. For stud spacings exceeding 16 inches o. c., solid blocking shall be installed behind all joints at right angles to framing members.

3. Other types of boards, including compressed dense composition board less than 1/2 inch thick may be used when acceptable to Chief Underwriter.

4. The method of joining dry wall finish shall be subject to the acceptance of the Chief Underwriter.

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414–E. Wood Trim.

1. *General.* The species and grade of interior wood trim shall be appropriate for the proposed use and this, together with workmanship in its installation, shall be of a quality suitable for the class of dwelling under consideration and shall be acceptable to the Chief Underwriter.

2. All interior trim shall be thoroughly seasoned and kiln-dried, and sanded free of tool marks and other objectionable defects.

3. Moisture content at the time of installation shall not exceed 12%.

4. Plaster and other building materials shall be dry at time of installation of trim.

5. All nail heads shall be set for putty seal.

414–F. Stair Walls and Soffits. Apply acceptable finish to all stair walls and soffits above first floor.

FINISH FLOORS. *Finish floors shall be installed.*

415–A. Cement Floors.

1. *Mix.* See 406–B.

2. *Heater Rooms, or floors under heaters.*

a. Cement floors installed on ground, see 406–E.

b. Reinforced structural slab.

c. When installed on wood framing: minimum thickness, 4 inches. Use sheet metal over tops of joists for concrete forms, or cut in 1 inch boards flush with tops of joists; remove boards after slab has set. Reinforce slab with wire mesh weighing not less than 30 pounds per 100 square feet, or with ¼ inch bars spaced 1 foot o. c. each way.

415–B. Wood Floors.

1. *Materials.*

a. Flooring shall be kiln-dried D. & M. material.

b. Strip flooring: If applied single thickness on wood joists or wood stripping, minimum thickness $^{25}/_{32}$-inch; if applied directly over subflooring without stripping; minimum thickness ⅜-inch. Maximum width for hardwood, 2¼-inches, for softwood 3¼-inches. Wider widths including plank flooring may be used when precautions are taken in installation to prevent warping or cupping.

c. Nails: use steel cut nails for flooring $^{25}/_{32}$ inch (finish) thickness; for flooring less than $^{25}/_{32}$ inch in thickness use bright wire casing nails.

d. Building paper or deadening felt shall be applied under all finish flooring.

2. *Installation.*

a. Finish flooring installed over subflooring shall be applied at right angles to wood board subflooring except when subflooring is laid diagonally. If applied over plywood, see 408–C–4–b. Single flooring shall have end joints over joists unless end-matched boards are used and no two adjoining boards break joints over same joist space and each board bears on at least two joists.

b. Strip flooring installed over concrete shall be applied on not less than 2 x 2 inch sleepers embedded in concrete or secured with metal clips to concrete. Sleepers embedded in concrete shall be pressure-treated with wood preservative. If slab bears on ground, underlay slab with membrane waterproofing. See 406–E.

c. Wood block flooring applied over concrete shall be set in mastic and installed in accordance with flooring manufacturer's directions.

415–C. Ceramic Tile. See 408–C–4–e.

1. *Grade* shall be Standard grade or better.

2. *Setting bed.* See details 36 and 37.

a. Mix: 1 part portland cement, 4 parts sand; or 1 part portland cement, 2 parts sand and 4 parts pea size aggregate.

b. Minimum thickness: 1¼ inches, if reinforced with wire mesh; 3 inches when installed below top of chamfered joists, with finish tile surface at least 1½ inches above tops of joists.

3. When applied over wood subfloor, install asphalt saturated felt over subfloor underneath the wire mesh. See details 36 and 37.

415–D. Rubber Tile, Asphalt Tile and Linoleum.

1. Rubber tile or linoleum on slabs resting on ground not acceptable. Asphalt tile may be used on slabs bearing on ground provided slab area where tile is to be applied has been underlaid with membrane waterproofing. See 406–E.
2. Install according to manufacturer's instructions.
3. Install over lining felt, approximately 1 pound per square yard, when applied over wood subflooring. See 408–C–4–d.
4. Adhesive for flooring shall be as recommended by manufacturer of the floor covering.
5. Other methods of linoleum installation may be used when acceptable to the Chief Underwriter.

GLAZING

416–A. Window Glass.

1. Minimum, B quality.
2. Factory-labeled on each pane.
3. Glass panes exceeding 12 inches in least dimension when installed in doors shall be not less than double strength.

416–B. Installation.

1. *Exterior work.*

a. Glass set in wood shall be secured in place with sprigs or glazing points and face-puttied. In doors, bed in putty and secure with exterior wood stops.

b. Glass set in metal shall be back-puttied and secured with glazing clips and face-puttied. Use special steel window putty.

2. *Interior work.*

a. Back and face-putty glass after setting.

b. Secure glass in place with stops or glazing beads.

3. *Mirrors:* install on wood blocks. If in doors, use felt cushions. Provide air space back of mirror for ventilation.

PAINTING AND DECORATING

417–A. Exterior work. Exterior work shall be finished as follows:

1. *Millwork.*

a. Prime coat shall be applied before or immediately after installation.

b. Nail holes and cracks shall be puttied after prime coat. Tint putty to match stained and varnished work.

c. Paint: minimum of 3 coats, including prime coat. See 417–A–9.

d. Varnish: use spar varnish where varnish finish is proposed; its use shall be limited to surfaces which are protected from the weather.

2. *Wood shingles.*

a. Sidewalls: apply 2 coats stain or 3 coats paint.

b. Roofs: apply stain or paint or leave unfinished.

3. Ends of wood siding shall be sealed with white lead paint before erection.

4. Cedar, cypress and redwood may be finished by methods acceptable to Chief Underwriter.

5. Top and bottom of exterior doors and sash, paint at least 2 coats.

6. All concrete block exterior walls, when exposed directly to the weather shall be waterproofed in the manner specified under 417–A–7–b.

7. *Waterproofing exterior masonry and stucco walls.*

a. When the exterior face of masonry or stucco exterior walls is to be waterproofed, a minimum of two coats of paint shall be applied.

b. Open texture walls: Concrete Block Construction.

(1) Cement-water paint. All cement-water paint shall comply with Federal Specifications TT–P–21, Type II. All containers shall bear the following printed statement: "This cement-water paint complies with Federal Specification TT–P–21, Type II, for cement-water paint".

First coat: Use Type II, Class B (with fine silica sand); the sand used shall pass a No. 20 sieve.

Second coat: Use Type II, either Class B or Class A (with or without sand).

(2) Ready-mixed paints of oil-base, synthetic resin-emulsion, oil-emulsion, and rubber-emulsion types and job-mixed white lead-in-oil paint for concrete, stucco, brick and similar masonry surfaces.

(3) All paint shall be mixed strictly in accordance with manufacturer's instructions.

c. Smooth surface walls (such as brick and stucco). Paint requirements shall be the same as in paragraph b above, except that if cement-water paint is used, the first coat need not contain the sand aggregate.

d. Application. All paint shall be applied by brush.

(1) Open texture walls, such as concrete block. Apply first coat by scrubbing paint on with stiff bristle brushes such as scrubbing brushes or fender brushes. Second coat may be brushed on with calcimine or whitewash brushes, if desired.

Note: After the application of cement-water paint, special attention should be given to curing by sprinkling gently with water for several days.

(2) Smooth textured walls. If desired, both coats may be applied with calcimine or whitewash brushes.

8. Ornamental iron, structural steel, and steel sash shall be painted with lead-in-oil, graphite or prepared paint, as recommended by manufacturer. One or more coats in addition to shop coat.

9. Specially prepared paints which necessitate modification of above requirements may be used when acceptable to Chief Underwriter.

10. In all cases of exterior paint work, if in the opinion of the Chief Underwriter, the finish paint job does not provide proper protection and hiding, he may require additional coats before acceptance.

11. Paint all exterior exposed sheet metal work at least two coats.

417–B. Interior Work. Finish interior work in a manner acceptable to the Chief Underwriter.

1. Plaster may be painted, papered or left natural. Exception, bathrooms and kitchens shall be painted or papered; if painted, use oil base paint; if papered, use washable paper.

a. If painted, minimum acceptable:

(1) Apply varnish size or specially prepared primer and two coats oil or varnish base paint.

(2) Apply casein size and one coat casein paint.

(3) Apply size and one coat resin emulsion.

(4) Special paint finishes may be used when applied and finished in

417–B. Interior Work. *Continued.*

accordance with manufacturer's instructions provided they are acceptable to the Chief Underwriter.

b. If papered:

(1) Size plaster with glue size.
(2) Use wall paper of quality commensurate with quality of dwelling.

2. Wall board or paneled walls: stain, paint or paper. Apply finish according to manufacturer's directions.

3. Wood trim, paneling and sash and doors including tops and bottoms shall be finished.

a. If painted: minimum acceptable, one prime coat and one finish coat; and if open-grain wood: one coat filler before application of paint coats.

b. If stained: stain and one coat of varnish; or stain and one coat wax. If smooth finish is desired on open-grain wood use filler after stain.

c. If natural wood finish: two coats varnish; or two coats wax; or one coat varnish and one coat wax.

417–C. Wood Floors. Wood floors shall be finished.

1. Open grain wood, one coat filler.

2. Minimum finish, all wood floors (in addition to filler, if open grain wood):

a. Two coats wax; or
b. Stain and two coats wax; or
c. One coat shellac, varnish or lacquer and one coat wax; or
d. Two coats varnish; or
e. Two coats floor enamel and one coat wax; or
f. One coat sealer and two coats wax.
g. Flooring prefinished at the factory may be used when acceptable to the Chief Underwriter.

417–D. Cement Floor Finish. When painted, neutralize all cement floors; apply two coats floor paint and one coat wax.

417–E. Metal.

1. Structural steel and iron and exposed surfaces of miscellaneous steel and iron shall have one coat rust inhibiting paint in addition to shop coat.

2. Ornamental iron shall have one coat rust inhibiting paint and one finish coat unless specially finished.

FINISH HARDWARE

418–A. General. Install hardware of quality commensurate with class of dwelling.

418–B. Exterior Hardware Material.

1. Bronze
2. Brass.
3. Ferrous metals when zinc or cadmium coated, or phosphate treated before painting.

418–C. Exterior Doors.

1. Use three butts.
2. Install cylinder-type lock on main entrance doors.

418–D. Bathroom Accessories. Install not less than the following in each bathroom: one medicine cabinet, two towel racks, one paper holder and two other accessories.

GARAGES

419–A. Attached or Built-in Garages.

1. Construction shall be consistent with that of the dwelling.
2. If door opening occurs between garage and dwelling the garage floor shall be lower than adjoining floor.
3. Install partition between space containing house heating unit and garage space. Do not install house heating unit in garage space.
4. Wood frame walls common to dwelling and garage and all walls and ceilings of built-in garages shall be finished in a manner acceptable to Chief Underwriter.
5. All wood doors in openings between garage and main dwelling shall be covered with sheet metal on the garage side.

419–B. One-story Detached Garages. Comply with construction requirements for one-story dwellings with the following exceptions:

1. Bottom of footings of frame garages shall be not less than 18 inches below finish grade, footings not less than 10-inches wide.

2. Studs, maximum spacing 24 inches o. c. Doubling of studs is not required on jambs of openings less than 3′–6″ wide.

3. Sheathing and building paper may be omitted.

4. Corner post may be two 2 x 4's or a 4″ x 4″.

5. Top plate may be single, provided rafters occur over studs, and plates at corners are lapped to provide ties.

6. Rafter ties at eaves may be 2 x 4's maximum spacing 6 ft. o. c.

7. Corner bracing may be applied on the inside surface of studs.

8. Flooring may be gravel or cinders. If concrete see 406–E.

9. Gutters and downspouts may be omitted.

HEATING REQUIREMENTS

500. Objective. *The objective of heating requirements is to assure (a) winter comfort by means of facilities providing a quality of performance as well as economy and convenience of operation; and (b) an adequate supply of hot water; both appropriate to the dwelling under consideration.*

GENERAL. *See 401. See also Appendix E for Detailed Heating Requirements which are a part of these Heating Requirements.*

501–A. Facilities for Heating.

1. Each dwelling shall be provided with facilities for heating. The heating equipment shall be new and durable, completely connected, in operating condition and properly balanced and adjusted at the time of final compliance inspection. The complete installation shall be safe, efficient, and economical in operation and shall provide an acceptably uniform distribution of heat throughout the dwelling.

2. Minimum acceptable quality of performance and the degree of convenience of operation shall at least be in conformance with the class of dwelling.

3. Provide facilities for fuel storage as required in 302–C–8.

501–B. Safety.

1. The installation of equipment shall comply with all applicable local laws and ordinances and with the current standards, regulations and recommendations published by the National Board of Fire Underwriters.

2. Coal-fired equipment shall not be installed on any floor above the first floor.

3. The products of combustion from all space heating and domestic water heating equipment in which solid, liquid, or gaseous fuel is burned shall be discharged into a chimney-flue or vent through an acceptable breeching provided with necessary dampers and controls.

4. The construction of all heating equipment and domestic water heating equipment and appurtenances shall conform to the requirements in applicable Codes and Standards.

5. Warm air distribution systems, either gravity or forced, shall be so arranged that the return ducts serving one living unit are not connected with those serving any other living unit and air returned from one living unit shall not be recirculated to another living unit.

6. Public halls shall not be used as plenums in warm air distribution systems.

501–C. Capacity of Heating Equipment.

1. The output capacity of a heating system, after deductions have been made for piping and pick-up losses, attached domestic hot-water heaters, and other connected loads shall be not less than the heat loss of the living unit or dwelling.

2. The output of overflow heaters, radiators, convectors, registers or other heat distribution devices shall be not less than the heat loss of the space or spaces which are to be heated. Distribution shall be proportioned to the heat losses of such space.

Note: Heat loss is the amount of heat in Btu per hour which escapes from the heated space in a dwelling, assuming that the temperature of that space is maintained at an acceptable comfort temperature and the distribution is acceptably uniform, when the outside temperature is at the design temperature established by FHA for the locality.

3. Where drawings indicate provisions for possible future expansion of the dwelling, the capacity of the heating equipment shall be sufficient to heat the dwelling including the future added area.

501–D. Design, Installation and Rating. Compliance is required with design, rating and installation requirements of applicable Codes and Standards acceptable to the Chief Underwriter.

501–E. Tests and Operating and Maintenance Instructions.

1. Tests, certifications and other data, when required to determine compliance with plans, specifications and requirements, shall be subject to the acceptance of the Chief Underwriter.

2. Printed guarantees, service agreements, operating and maintenance instructions regularly furnished by the manufacturer and installer or as may be additionally required by the Chief Underwriter, shall be posted on or adjacent to the equipment to which they apply, before final inspection.

501–F. Special Methods and Systems of Heating. Any proposed method of heating not adequately covered by these requirements shall be considered a special method. In such cases fully detailed drawings, description, and adequate design data shall be submitted in accordance with the procedure provided for special methods of construction as set forth in Federal Housing Administration circular "Rulings on New Methods of Construction and Determination of Acceptability of Individual Materials," current issue and the proposed design accepted by the Chief Underwriter before construction.

DOMESTIC WATER HEATING AND STORAGE

502. General. Each dwelling shall be provided with facilities for heating domestic hot water. The domestic hot water heating equipment shall be new, durable, completely connected and in operating condition at the time of final inspection. The complete installation shall be safe, efficient and economical in operation and shall provide an acceptable supply of domestic hot water. *See Appendix F for Detailed Domestic Water Heating and Storage Requirements which are a part of these Heating Requirements.*

CHIMNEY-FLUES AND VENTS

503–A. A separate flue is required for each heating appliance which depends upon sustained chimney draft for proper operation. The domestic hot water heating equipment may be vented into the heating appliance flue when approved by the Chief Underwriter.

503–B. The chimney shall be of such height, size and construction as to create sufficient draft to develop the rated output of the equipment served and not less than recommended by the equipment manufacturer. In no case shall the height be less than 2 feet above the ridge of the roof that the chimney penetrates and not less than 2 feet above the highest ridge within 10 feet of the chimney.

503–C. Limitations According to Fuel Used.

1. Masonry type chimneys are acceptable for use with all fuels. For masonry chimneys, see 406–L.

2. Other chimneys, flues or vents may be used if acceptable to the Chief Underwriter for the fuel used.

3. Vents listed or approved by Underwriters' Laboratories only for gas-fired equipment are acceptable for use only with gas as fuel.

a. Installation shall provide clearances according to requirements in Underwriters' Laboratories Approval Report.

b. Provide means to dispose of condensation.

c. Effective area shall be at least equal to area of vent outlet of largest appliance plus at least 50 percent of combined area of vent outlets of all other gas equipment connected to it.

d. Vents shall extend through roof as near ridge as practicable with crossovers not less than 22½° with the horizontal.

e. Height at least 2 feet above the highest portion of any structure within 10 feet of vent.

f. Vent cap shall be designed to prevent downdraft under normal conditions of operation.

PLUMBING AND SANITATION REQUIREMENTS

600. Objective. *The objective of plumbing and sanitation requirements is (a) to provide a properly installed system of piping and plumbing fixtures, appropriate to the size and class of dwelling under consideration, supplied with hot and cold water in adequate volume and pressure for cooking, laundering, bathing and toilet purposes; and (b) to provide a water-carriage sewerage system for the safe disposal of wastes from fixtures and installed in a manner to provide healthful and sanitary living conditions.*

GENERAL. *See 401.*

601–A. Codes and Regulations. Comply with the following:

1. State and Local regulations.

2. Plumbing Manual, (Report BMS No. 66 or later revision) of the National Bureau of Standards, U. S. Department of Commerce, shall be complied with when, in the opinion of the Chief Underwriter, local codes and regulations are inadequate to provide proper sanitary protection, or where no State or local regulations exist.

3. Evidence of approval shall be required when inspection is required by State or local authority. Chief Underwriter may require plumbing tests where not otherwise required.

4. Domestic hot water systems shall comply with 502 and Appendix F.

FIXTURES

602–A. Minimum Fixtures. Each living unit shall contain at least one kitchen sink, one water closet, one lavatory, one bathtub and one laundry tray. Kitchen sink and tray combination or hot and cold water faucets with floor drain acceptable in lieu of laundry tray.

602–B. Installation.

1. All fixtures shall be securely installed.
2. Tubs shall be hung on metal supports or end grain of wood blocks secured to the wall construction. See detail 38.

PIPING

603–A. General.

1. Materials shall be new and durable.

2. Size of pipe shall be adequate in relation to fixtures served.

3. All piping shall be installed without damage to structural members. See 408–B–1 and detail 17.

4. All water piping shall be properly sloped and protected against freezing.

603–B. Supply Lines.

1. Service line shall be laid on solid ground and below frost line. Service line may be laid in same trench with sewer line provided water line is not less than 1 foot higher than the sewer and laid on solid ledge of ground.

2. Cold water lines shall be installed and connected to all fixtures and hot water lines to all fixtures except water closet.

3. Cross-connections between the drinking water supply and supplies not intended for drinking purposes will not be acceptable.

4. A shut-off valve on main water supply line serving each living unit shall be provided in an easily accessible location within the building.

5. Drain valves so located as to permit drainage of the entire system within the building shall be installed.

603–C. Drains.

1. House sewer pipe shall be laid with barrel on solid ground, excavating bell hole for each pipe. Make joints watertight and where necessary protect against penetration by roots of shrubbery or trees.

2. Drain lines of proper size shall be installed and connected to all fixtures.

3. All building drainage lines from base of stack to house sewer connection shall be extra heavy cast iron pipe, unless pipe of other material is specifically approved by the Chief Underwriter.

4. Cleanouts shall be provided at base of main stack and at all bends in excess of 45 degrees.

5. Shower stall drains shall be made watertight.

6. Traps subject to freezing shall be protected.

WATER SUPPLY

604–A. General.

1. Each living unit shall be provided with an adequate supply of safe and palatable water connected to the required fixtures.

2. The water shall comply in quality with the requirements of the State Department of Health.

604–B. Source of Water Supply.

1. Wherever available, connection shall be made to a public water system.

2. Where a public system is not available, connection to an approved community system is acceptable.

a. To be acceptable a community system shall comply with all State and local laws and regulations.

b. Evidence shall be submitted showing that the system and the water it provides are considered satisfactory by the State Department of Health.

3. Where neither a public nor an acceptable community system is available, an individual water system is acceptable provided compliance is obtained with the following:

a. All individual water systems shall comply with the Federal Housing Administration "Requirements for Individual Water-Supply and Sewage-Disposal Systems," for the State in which the property is located.

b. Evidence shall be presented showing that the installation of each individual water supply system is satisfactory to the health authority having jurisdiction. Form No. 2217–13 is prepared for this use.

SEWAGE DISPOSAL

605–A. General. Each living unit shall be provided with an adequate and safe method of sewage disposal by a water-carriage system.

605–B. Method of Sewage Disposal.

1. Wherever available, connection shall be made to public sewerage system.

2. Where a public system is not available, connection to an approved community system will be acceptable.

a. To be acceptable a community system shall comply with all State and local laws and regulations.

b. Evidence shall be submitted showing that the system and the method of disposal are considered satisfactory by the State Department of Health.

3. Where neither a public nor acceptable community system is available, an individual sewage-disposal system is acceptable provided compliance is obtained with the following:

a. All individual sewage disposal systems shall comply with the Federal Housing Administration "Requirements for Individual Water-Supply and Sewage-Disposal Systems," for the State in which the property is located.

b. Evidence shall be presented showing that the installation of each individual sewage-disposal system is satisfactory to the health authority having jurisdiction. Form No. 2218–13 is prepared for this use.

MISCELLANEOUS DRAINAGE. *See 803.*

ELECTRIC REQUIREMENTS

700. Objective. *The objective of electric requirements is to obtain a system of wiring properly installed to safely provide electric current adequate for efficient illumination and for safe and efficient operation of such appliances and equipment as are considered essential and appropriate to the class of dwelling under consideration.*

GENERAL. *See 401.*

701–A. Facilities for Electric Service. Electrical service shall be provided for each living unit.

701–B. Codes and Regulations. Installations shall comply with:

1. State and Local regulations.

2. National Electrical Code of the National Board of Fire Underwriters when, in the opinion of the Chief Underwriter, local regulations are inadequate to provide proper electrical service.

3. National Electrical Code where no local or State regulations exist.

4. Evidence of compliance with applicable regulations shall be shown whenever required by State or local authority.

MATERIALS

702–A. Materials shall be new and shall conform to standards of Underwriters' Laboratories, Inc.

702–B. Reduction in wire size shall not be permitted between appliance or outlet and the distribution panel.

702–C. Minimum Wire Size.

1. Outside service connection, No. 6.
2. Light-duty branch circuits, No. 14.
3. Circuits serving kitchen and laundry, No. 12.
4. Heavy-duty branch circuits, No. 12.
5. Small motors, No. 12.
6. Heaters, No. 10.
7. Ranges, No. 8.

INSTALLATIONS

703–A. Circuits. Install at least one circuit for each 500 square feet of floor area; minimum, two per living unit. Make provision for at least one future circuit.

703–B. Outlets.

1. Ceiling fixtures shall be installed in kitchens, halls, dining rooms and bedrooms.

2. In bathrooms, wall fixture and convenience outlet shall be installed at mirror.

3. An outside fixture shall be installed at each main entrance and porch.

4. *Convenience outlets.*

a. Living room shall be provided with one duplex outlet between all doors and between doors and fireplace, when separated sufficiently for placement of furniture.

b. When ceiling fixtures are installed, minimum number:

(1) Dining room or dining space, one duplex outlet.

(2) Each other habitable room, including kitchen, two duplex outlets.

c. In rooms where ceiling fixtures are not required and not installed, minimum number, three duplex outlets.

5. Special purpose outlets shall be installed for each unit of equipment such as electric ranges.

6. At least one ceiling outlet shall be provided in each attached or built-in garage, attic served by stairway, and basement.

7. Install ceiling or wall outlets to provide illumination for all portions of stairways and stair halls.

703–C. Switches.

1. Each ceiling fixture in habitable rooms, and stair hall shall be controlled by wall switch.

2. When ceiling fixtures are not installed at least one outlet per habitable room shall be controlled by a wall switch.

3. Bathroom fixture shall be controlled by a wall switch not readily accessible from tub or shower.

4. For upper floor living units or those occupying more than one floor, provide at least one three-way switch conveniently located on each floor to control at least one light which illuminates the stairs. This shall include basement stairs when garage is built-in on basement level and access is through the basement.

5. Exterior fixtures shall be controlled by wall switches inside the entrance doors.

6. Switches shall not be placed behind doors.

LOT IMPROVEMENT REQUIREMENTS

800. Objective. *The objective of lot improvement requirements is (a) to obtain an arrangement of the physical improvements on the lot or plot so that convenient means of access to the dwelling and accessory buildings is provided for both pedestrians and vehicles; (b) to provide positive drainage of the lot or plot and the diversion of water away from buildings and its disposal from the site; and (c) to provide an attractive setting for the dwelling by means of lot improvements, including planting, seeding and sodding commensurate with the class of property under consideration.*

GENERAL. *See 401.*

801. Grading or drainage or both shall be performed so that water will drain away from the building on all sides and off the lot in a manner which will provide reasonable freedom from erosion and pocketed surface water. Construction such as walks, driveways and retaining walls shall be installed so that they will not interfere with drainage.

ROUGH GRADING

802–A. Where lawns and planting are required and regrading is necessary, the area shall be rough graded to proper levels to receive topsoil. All other areas, where grading is necessary, may be rough graded to the finish grade elevations. The rough grading shall provide for proper establishment of slopes and finish grade elevations. See 801 and 805.

802–B. Fills shall be free of debris and shall be properly compacted.

802–C. Heavy equipment shall not be used over septic tanks or tile fields.

DRAINAGE STRUCTURES. *See also 406–D–6, and 413–D.*

803–A. Where protection against erosion or other damage by surface water or ground water is considered necessary by the Chief Underwriter, precautionary measures shall be taken such as installation of subsurface drainage structures or paved gutters with proper outlets.

803–B. In all locations where surface water is pocketed, catch basins shall be installed and properly connected to adequate and positive means of water disposal.

DRIVEWAYS

804. A driveway shall be provided when a garage is included or when specifically required by the Chief Underwriter. The driveway shall be constructed with a substantial base and an all-weather properly drained surface of a width and gradient to provide convenient access during all seasons. If constructed of concrete see 406–E.

FINISH GRADING

805–A. All debris shall be removed from the rough-graded area before finish grading. The finished surface of all areas shall be reasonably smooth and even and shall conform with the elevations required below. Areas where lawns and planting are required shall have suitable topsoil of adequate depth to support plant growth.

805–B. Finish grade elevations around buildings shall provide continuous slopes away from foundation walls. Where any slope away from a building meets a slope towards a building, the bottom of the swale or valley formed by the two slopes shall be at least 1 foot below the finish grade elevations at the walls, shall be pitched to provide surface water run-off to public drainage and, except as prohibited by nearness of lot lines, shall be at least 10 feet away from the foundation walls.

805–C. The finish grade elevations of all unpaved areas shall provide continuous slopes of at least 6 inches in 25 feet (2% gradient) to lower elevations off the lot or to drainage structures on the lot. Where catch basins or inlets are installed, the finish grade elevations of adjoining areas shall provide for emergency surface overflow without flooding against buildings.

805–D. Finish grade elevations around individual wells shall be the same as for buildings in B and C above.

805–E. The height and steepness of slopes and the gradients of unpaved swales or valleys shall be such as to provide stability and reasonable freedom from erosion. Where considered necessary by the Chief Underwriter, precautionary measures shall be taken such as installation of retaining walls, sodding or planting to stabilize the soil.

WALKS, STEPS, SEEDING, SODDING AND PLANTING

806. The location and extent of walks, outside steps, retaining walls, topsoil requirements, seeding, sodding or sprigging and planting shall be subject to the acceptance of the Chief Underwriter. Walks and outside steps shall be arranged to provide for safe and convenient use. If walks are constructed of concrete see 406–E. Lawns and planting, and retaining walls if any, shall be arranged to provide an attractive setting for the dwelling.

699071 O—47——6

APPENDIX A

TABLES OF MAXIMUM ALLOWABLE SPANS for Wood Floor Joists, Ceiling Joists and Rafters

Included herein are the species of framing lumber most frequently used in the area under the jurisdiction of this office. Allowable spans for other species of lumber may be obtained from the FHA office.

DOUGLAS FIR

Coast Region

Table 1.—FLOOR JOISTS

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	No. 1 dimension	1200–f	900–f	No. 2 dimension
	In.	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*
2 x 6	12	11 3	11 3	11 3	10 0
	16	10 2	10 2	10 2	8 8
	20	9 6	9 6	9 2	7 9
	24	8 11	8 11	8 4	7 1
2 x 8	12	15 0	15 0	15 0	14 3
	16	13 8	13 8	13 8	12 5
	20	12 8	12 8	12 2	11 0
	24	11 11	11 11	11 1	10 2
3 x 8	12	17 8	17 8	17 8	17 8
	16	16 0	16 0	16 0	15 11
	20	14 11	14 11	14 11	14 1
	24	14 0	14 0	14 0	12 10
2 x 10	12	19 0	19 0	19 0	18 9
	16	17 3	17 3	17 3	16 3
	20	16 1	16 1	15 5	14 7
	24	15 1	15 1	14 1	13 4
3 x 10	12	22 4	22 4	22 4	22 4
	16	20 3	20 3	20 3	20 3
	20	18 10	18 10	18 10	18 6
	24	17 9	17 9	17 9	16 11
2 x 12	12	23 0	23 0	23 0	23 0
	16	20 10	20 10	20 10	20 10
	20	19 5	19 5	18 8	18 8
	24	18 3	18 3	17 1	17 1

ROUGH LUMBER

2 x 6	12	12 10	12 10	12 10	11 9
	16	11 8	11 8	11 8	10 3
	20	10 10	10 10	10 10	9 1
	24	10 3	10 3	9 10	8 4
2 x 8	12	17 2	17 2	17 2	16 11
	16	15 7	15 7	15 7	14 7
	20	14 6	14 6	14 5	13 1
	24	13 7	13 7	13 3	11 11
3 x 8	12	19 8	19 8	19 8	19 8
	16	17 10	17 10	17 10	17 10
	20	16 7	16 7	16 7	16 0
	24	15 7	15 7	15 7	14 7
2 x 10	12	21 6	21 6	21 6	21 6
	16	19 6	19 6	19 6	19 0
	20	18 1	18 1	18 0	17 0
	24	17 1	17 1	16 6	15 6
3 x 10	12	24 7	24 7	24 7	24 7
	16	22 4	22 4	22 4	22 4
	20	20 8	20 8	20 8	20 8
	24	19 6	19 6	19 6	19 0
2 x 12	12	25 9	25 9	25 9	25 9
	16	23 5	23 5	23 5	23 5
	20	21 8	21 8	21 7	21 7
	24	20 5	20 5	19 9	19 9

DOUGLAS FIR

Coast Region

Table II.—FLAT ROOF JOISTS

[Roof slopes 3 in 12 and less. Span is the horizontal distance between supports]

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	Supporting finished ceiling								Not supporting finished ceiling							
		No. 1 Dimension		1200-f		900-f		No. 2 Dimension		No. 1 Dimension		1200-f		900-f		No. 2 Dimension	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 6	12	13	0	14	0	12	1	10	2	15	4	15	7	14	4	12	1
	16	11	3	12	1	10	6	8	10	13	4	14	2	12	6	10	6
	20	10	1	10	10	9	5	7	11	11	11	12	10	11	1	9	4
	24	9	2	9	11	8	7	7	3	10	10	11	9	10	2	8	7
2 x 8	12	18	8	18	8	16	2	14	8	20	10	20	10	19	2	17	5
	16	16	2	16	2	14	0	12	8	18	11	18	11	16	7	15	1
	20	14	6	14	6	12	6	11	5	17	2	17	2	14	10	13	5
	24	13	2	13	2	11	5	10	5	15	7	15	7	13	6	12	4
3 x 8	12	23	9	23	9	20	7	18	8	24	5	24	5	24	4	22	1
	16	20	7	20	7	17	10	16	2	22	2	22	2	21	1	19	2
	20	18	5	18	5	15	11	14	5	20	7	20	7	18	10	17	1
	24	16	9	16	9	14	6	13	2	19	5	19	5	17	2	15	7
2 x 10	12	23	7	23	7	20	6	19	4	26	4	26	4	24	2	22	10
	16	20	5	20	5	17	9	16	9	24	0	24	0	21	0	19	10
	20	18	4	18	4	15	10	15	0	21	8	21	8	18	9	17	8
	24	16	8	16	8	14	6	13	8	19	9	19	9	17	1	16	2
3 x 10	12	30	0	30	0	26	0	24	7	31	0	31	0	30	8	29	0
	16	26	0	26	0	22	7	21	3	28	1	28	1	26	8	25	2
	20	23	4	23	4	20	2	19	1	26	1	26	1	23	10	22	5
	24	21	2	21	2	18	5	17	4	24	7	24	7	21	8	20	6
2 x 12	12	28	7	28	7	24	10	24	10	31	10	31	10	29	4	29	4
	16	24	10	24	10	21	5	21	5	29	0	29	0	25	5	25	5
	20	22	2	22	2	19	2	19	2	26	2	26	2	22	8	22	8
	24	20	3	20	3	17	6	17	6	24	0	24	0	20	9	20	9
ROUGH LUMBER																	
2 x 6	12	15	4	16	7	14	4	12	1	17	10	17	10	17	0	14	4
	16	13	3	14	4	12	5	10	6	15	9	16	2	14	9	12	5
	20	11	10	12	10	11	1	9	4	14	1	15	1	13	2	11	1
	24	10	10	11	8	10	2	8	7	12	10	13	10	12	0	10	1
2 x 8	12	22	1	22	1	19	1	17	4	23	9	23	9	22	7	20	6
	16	19	1	19	1	16	7	15	0	21	7	21	7	19	7	17	9
	20	17	1	17	1	14	10	13	5	20	1	20	1	17	6	15	11
	24	15	7	15	7	13	6	12	3	18	6	18	6	16	0	14	6
3 x 8	12	27	0	27	0	23	5	21	3	27	2	27	2	27	2	25	2
	16	23	5	23	5	20	3	18	5	24	9	24	9	24	0	21	10
	20	21	0	21	0	18	2	16	6	23	0	23	0	21	5	19	6
	24	19	2	19	2	16	7	15	0	21	7	21	7	19	7	17	9
2 x 10	12	27	7	27	7	23	11	22	7	29	9	29	9	28	3	26	8
	16	23	11	23	11	20	8	19	6	27	0	27	0	24	6	23	2
	20	21	5	21	5	18	6	17	6	25	1	25	1	21	11	20	8
	24	19	6	19	6	16	11	15	11	23	1	23	1	20	0	18	11
3 x 10	12	33	10	33	10	29	4	27	8	34	2	34	2	34	2	32	8
	16	29	4	29	4	25	4	23	11	31	0	31	0	30	0	28	5
	20	26	3	26	3	22	8	21	5	28	10	28	10	26	10	25	4
	24	23	11	23	11	20	9	19	6	27	0	27	0	24	6	23	2
3 x 12	12	33	2	33	2	28	8	28	8	35	8	35	8	34	0	34	0
	16	28	8	28	8	24	10	24	10	32	6	32	6	29	5	29	5
	20	25	8	25	8	22	3	22	3	30	1	30	1	26	3	26	3
	24	23	5	23	5	20	4	20	4	27	9	27	9	24	0	24	0

DOUGLAS FIR

Coast Region

Table III.—CEILING JOISTS

Nominal size (inches)	Spacing c. to c.	Limited attic storage								No attic storage							
		No. 1 Dimension		1200–f		900–f		No. 2 Dimension		No. 1 Dimension		1200–f		900–f		No. 2 Dimension	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 4	12	7	7	9	2	8	5	5	9	11	6	11	6	11	6	10	0
	16	6	7	8	3	7	4	5	0	10	6	10	6	10	6	8	8
	20	5	10	7	7	6	7	4	6	9	8	9	8	9	8	7	9
	24	5	4	7	0	6	0	4	1	9	1	9	1	9	1	7	1
2 x 6	12	14	0	14	2	13	1	11	1	17	10	17	10	17	10	17	10
	16	12	2	12	10	11	4	9	7	16	5	16	5	16	5	16	5
	20	10	10	11	9	10	2	8	7	15	0	15	0	15	0	14	10
	24	9	11	10	9	9	3	7	10	14	2	14	2	14	2	13	7
2 x 8	12	18	11	18	11	17	6	15	10	23	10	23	10	23	10	23	10
	16	17	1	17	1	15	2	13	9	21	10	21	10	21	10	21	10
	20	15	8	15	8	13	7	12	4	20	0	20	0	20	0	20	0
	24	14	4	14	4	12	5	11	3	18	11	18	11	18	11	18	11
2 x 10	12	23	11	23	11	22	1	20	11	----	----	----	----	----	----	----	----
	16	21	8	21	8	19	3	18	1	----	----	----	----	----	----	----	----
	20	19	10	19	10	17	2	16	2	----	----	----	----	----	----	----	----
	24	18	1	18	1	15	8	14	9	----	----	----	----	----	----	----	----

Table IV.—RAFTERS

[Roof slopes greater than 3 in 12. Span is the actual length of the rafter between the plate and the ridge or an intermediate support]

Nominal size (inches)	Spacing c. to c.	No. 1 Dimension				1200–f				900–f				No. 2 Dimension			
		Light roofing		Heavy roofing		Light roofing		Heavy roofing		Light roofing		Heavy roofing		Light roofing		Heavy roofing	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 4	12	9	6	8	5	12	3	10	11	10	7	9	5	7	3	6	5
	16	8	3	7	4	10	8	9	5	9	2	8	2	6	4	5	7
	20	7	4	6	7	9	6	8	5	8	3	7	4	5	8	5	0
	24	6	8	6	0	8	8	7	8	7	6	6	8	5	2	4	7
2 x 6	12	17	7	15	8	19	0	16	11	16	5	14	8	13	11	12	4
	16	15	3	13	7	16	6	14	8	14	3	12	8	12	0	10	8
	20	13	7	12	2	14	8	13	1	12	9	11	4	10	9	9	7
	24	12	5	11	1	13	5	12	0	11	8	10	4	9	10	8	9
2 x 8	12	25	3	22	7	25	3	22	7	22	0	19	6	19	11	17	8
	16	22	0	19	6	22	0	19	6	19	0	16	11	17	3	15	4
	20	19	8	17	6	19	8	17	6	17	0	15	2	15	5	13	9
	24	17	11	16	0	17	11	16	0	15	6	13	10	14	1	12	6
2 x 10	12	32	1	28	7	32	1	28	7	27	10	24	9	26	2	23	4
	16	27	10	24	8	27	10	24	8	24	1	21	5	22	8	20	2
	20	24	10	22	2	24	10	22	2	21	6	19	2	20	3	18	1
	24	22	8	20	2	22	8	20	2	19	8	17	6	18	6	16	6

Light roofing: Material weighing, in place, 5 pounds or less per square foot.
Heavy roofing: Material weighing, in place, over 5 pounds per square foot.

EASTERN HEMLOCK

Table II.—FLAT ROOF JOISTS

[Roof slopes 3 in 12 and less. Span is the horizontal distance between supports]

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	Supporting finished ceiling								Not supporting finished ceiling							
		No. 1 common dimension		1000 S. G.		900 S. G.		800 S. G.		No. 1 common dimension		1000 S. G.		900 S. G.		800 S. G.	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 6	12	10	4	12	10	12	1	11	5	12	3	13	10	13	10	13	6
	16	9	0	11	1	10	6	9	11	10	8	12	6	12	6	11	8
	20	8	0	9	11	9	5	8	10	9	6	11	7	11	1	10	5
	24	7	4	9	1	8	7	8	1	8	8	10	8	10	2	9	6
2 x 8	12	14	3	17	1	16	2	15	3	16	10	18	5	18	5	18	0
	16	12	4	14	9	14	0	13	2	14	7	16	8	16	7	15	8
	20	11	0	13	2	12	6	11	10	13	1	15	6	14	10	14	0
	24	10	1	12	0	11	5	10	10	11	11	14	3	13	6	12	9
3 x 8	12	18	1	21	7	20	7	19	5	21	4	21	7	21	7	21	7
	16	15	7	18	9	17	10	16	10	18	6	19	7	19	7	19	7
	20	14	0	16	9	15	11	15	0	16	6	18	3	18	3	17	9
	24	12	9	15	4	14	6	13	8	15	1	17	1	17	1	16	2
2 x 10	12	20	4	21	7	20	6	19	4	23	3	23	3	23	3	22	10
	16	17	7	18	8	17	9	16	9	20	10	21	2	21	0	19	10
	20	15	9	16	8	15	10	15	0	18	8	19	7	18	9	17	8
	24	14	5	15	3	14	6	13	8	17	0	18	1	17	1	16	2
3 x 10	12	25	10	27	3	26	0	24	7	27	3	27	3	27	3	27	3
	16	22	4	23	8	22	7	21	3	24	10	24	10	24	10	24	10
	20	20	0	21	2	20	2	19	1	23	0	23	0	23	0	22	5
	24	18	4	19	5	18	5	17	4	21	7	21	8	21	8	20	6
2 x 12	12	24	7	26	2	24	10	23	5	28	2	28	2	28	2	27	7
	16	21	4	22	7	21	5	20	3	25	3	25	7	25	5	24	0
	20	19	1	20	2	19	2	18	1	22	7	23	9	22	8	21	5
	24	17	5	18	6	17	6	16	6	20	7	21	10	20	9	19	7

ROUGH LUMBER

2 x 6	12	12	3	15	1	14	4	13	6	14	6	15	9	15	9	15	9
	16	10	8	13	1	12	5	11	9	12	7	14	4	14	4	13	11
	20	9	6	11	8	11	1	10	6	11	3	13	3	13	2	12	5
	24	8	8	10	8	10	2	9	7	10	3	12	6	12	0	11	4
2 x 8	12	16	11	20	2	19	1	18	0	20	0	21	0	21	0	21	0
	16	14	7	17	5	16	7	15	7	17	4	19	1	19	1	18	6
	20	13	1	15	7	14	10	14	0	15	5	17	8	17	6	16	6
	24	11	11	14	3	13	6	12	9	14	1	16	8	16	0	15	1
3 x 8	12	20	8	24	0	23	5	22	0	24	0	24	0	24	0	24	0
	16	17	11	21	5	20	3	19	1	21	2	21	10	21	10	21	10
	20	16	0	19	1	18	2	17	1	18	11	20	3	20	3	20	2
	24	14	7	17	6	16	7	15	7	17	3	19	1	19	1	18	6
2 x 10	12	23	10	25	2	23	11	22	7	26	3	26	3	26	3	26	3
	16	20	7	21	10	20	8	19	6	23	10	23	10	23	10	23	2
	20	18	5	19	6	18	6	17	6	21	10	22	2	21	11	20	8
	24	16	10	17	10	16	11	15	11	19	11	20	10	20	0	18	11
3 x 10	12	29	2	30	0	29	4	27	8	30	0	30	0	30	0	30	0
	16	25	2	26	9	25	4	23	11	27	4	27	4	27	4	27	4
	20	22	7	23	11	22	8	21	5	25	4	25	4	25	4	25	4
	24	20	8	21	10	20	9	19	6	23	10	23	10	23	10	23	2
2 x 12	12	28	6	30	2	28	8	27	0	31	6	31	6	31	6	31	6
	16	24	8	26	2	24	10	23	5	28	7	28	7	28	7	27	9
	20	22	1	23	5	22	3	20	11	26	2	26	7	26	3	24	9
	24	20	2	21	5	20	4	19	1	23	10	25	0	24	0	22	7

EASTERN HEMLOCK

Table III.—CEILING JOISTS

Nominal size (inches)	Spacing c. to c.	Limited attic storage								No attic storage							
		No. 1 Common Dimension		1000 S. G.		900 S. G.		800 S. G.		No. 1 Common Dimension		1000 S. G.		900 S. G.		800 S. G.	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 4	12	6	6	8	1	8	1	8	0	10	2	10	2	10	2	10	2
	16	5	7	7	4	7	4	6	11	9	3	9	3	9	3	9	3
	20	5	0	6	10	6	7	6	2	8	6	8	6	8	6	8	6
	24	4	7	6	4	6	0	5	8	7	11	8	1	8	1	8	1
2 x 6	12	11	3	12	6	12	6	12	4	15	9	15	9	15	9	15	9
	16	9	9	11	4	11	4	10	8	14	6	14	6	14	6	14	6
	20	8	8	10	7	10	2	9	7	13	3	13	3	13	3	13	3
	24	7	11	9	9	9	3	8	9	12	6	12	6	12	6	12	6
2 x 8	12	15	5	16	8	16	8	16	5	21	1	21	1	21	1	21	1
	16	13	4	15	1	15	1	14	3	19	3	19	3	19	3	19	3
	20	11	11	14	2	13	7	12	9	17	7	17	7	17	7	17	7
	24	10	11	13	0	12	5	11	8	16	8	16	8	16	8	16	8
2 x 10	12	21	1	21	1	21	1	20	11	----	----	----	----	----	----	----	----
	16	19	1	19	2	19	2	18	1	----	----	----	----	----	----	----	----
	20	17	0	17	10	17	2	16	2	----	----	----	----	----	----	----	----
	24	15	7	16	6	15	8	14	9	----	----	----	----	----	----	----	----

Table IV.—RAFTERS

[Roof slopes greater than 3 in 12. Span is the actual length of the rafter between the plate and the ridge or an intermediate support]

Nominal size (inches)	Spacing c. to c.	No. 1 Common Dimension				1000 S. G.				900 S. G.				800 S. G.			
		Light roofing		Heavy roofing		Light roofing		Heavy roofing		Light roofing		Heavy roofing		Light roofing		Heavy roofing	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 4	12	8	2	7	3	11	2	9	11	10	7	9	5	10	0	8	11
	16	7	1	6	3	9	8	8	8	9	2	8	2	8	8	7	9
	20	6	4	5	7	8	8	7	9	8	3	7	4	7	9	6	11
	24	5	9	5	2	7	11	7	1	7	6	6	8	7	1	6	4
2 x 6	12	14	1	12	7	17	4	15	5	16	5	14	8	15	6	13	10
	16	12	2	10	10	15	0	13	4	14	3	12	8	13	5	12	0
	20	10	11	9	9	13	5	11	11	12	9	11	4	12	0	10	8
	24	10	0	8	10	12	3	10	11	11	8	10	4	11	0	9	9
2 x 8	12	19	5	17	3	23	2	20	7	22	0	19	6	20	8	18	5
	16	16	10	14	11	20	0	17	10	19	0	16	11	17	11	15	11
	20	15	0	13	4	17	11	15	11	17	0	15	2	16	0	14	3
	24	13	8	12	2	16	4	14	7	15	6	13	10	14	8	13	0
2 x 10	12	27	8	24	7	29	3	26	0	27	10	24	9	26	2	23	4
	16	24	0	21	3	25	5	22	7	24	1	21	5	22	8	20	2
	20	21	5	19	0	22	8	20	2	21	6	19	2	20	3	18	1
	24	19	7	17	5	20	8	18	5	19	8	17	6	18	6	16	6

Light roofing: Material weighing, in place, 5 pounds or less per square foot.
Heavy roofing: Material weighing, in place, over 5 pounds per square foot.

WESTERN HEMLOCK

Table I.—FLOOR JOISTS

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	No. 1 Dimension	No. 2 Dimension	1200–f	900–f
	In.	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*
2 x 6	12	10 9	9 2	10 9	10 9
	16	9 9	8 0	9 9	9 9
	20	9 1	7 2	9 1	9 1
	24	8 3	6 7	8 7	8 4
2 x 8	12	14 4	13 3	14 4	14 4
	16	13 0	11 6	13 0	13 0
	20	12 2	10 4	12 2	12 2
	24	11 5	9 5	11 5	11 1
3 x 8	12	16 11	16 11	16 11	16 11
	16	15 4	14 7	15 4	15 4
	20	14 3	13 2	14 3	14 3
	24	13 5	11 11	13 5	13 5
2 x 10	12	18 2	17 6	18 2	18 2
	16	16 6	15 2	16 6	16 6
	20	15 4	13 6	15 4	15 4
	24	14 5	12 4	14 5	14 2
3 x 10	12	21 4	21 4	21 4	21 4
	16	19 4	19 3	19 4	19 4
	20	18 0	17 2	18 0	18 0
	24	16 11	15 9	16 11	16 11
2 x 12	12	22 0	22 0	22 0	22 0
	16	20 0	19 6	20 0	20 0
	20	18 7	17 4	18 7	18 7
	24	17 5	15 11	17 5	17 1

ROUGH LUMBER

2 x 6	12	12 4	10 11	12 4	12 4
	16	11 2	9 6	11 2	11 2
	20	10 5	8 6	10 5	10 5
	24	9 9	7 9	9 9	9 9
2 x 8	12	16 5	15 9	16 5	16 5
	16	14 11	13 7	14 11	14 11
	20	13 10	12 2	13 10	13 10
	24	13 0	11 0	13 0	13 0
3 x 8	12	18 10	18 10	18 10	18 10
	16	17 1	16 9	17 1	17 1
	20	15 10	15 0	15 10	15 10
	24	14 11	13 7	14 11	14 11
2 x 10	12	20 6	20 5	20 6	20 6
	16	18 8	17 8	18 8	18 8
	20	17 4	15 10	17 4	17 4
	24	16 3	14 5	16 3	16 3
3 x 10	12	23 6	23 6	23 6	23 6
	16	21 4	21 4	21 4	21 4
	20	19 10	19 4	19 10	19 10
	24	18 8	17 8	18 8	18 8
2 x 12	12	24 7	24 7	24 7	24 7
	16	22 4	22 4	22 4	22 4
	20	20 9	20 1	20 9	20 9
	24	19 7	18 4	19 7	19 7

WESTERN HEMLOCK

Table II.—FLAT ROOF JOISTS

[Roof slopes 3 in 12 and less. Span is the horizontal distance between supports]

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	Supporting finished ceiling								Not supporting finished ceiling							
		No. 1 Dimension		No. 2 Dimension		1200–f		900–f		No. 1 Dimension		No. 2 Dimension		1200–f		900–f	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 6	12	12	1	9	6	14	0	12	1	14	3	11	2	14	11	14	4
	16	10	5	8	2	12	1	10	6	12	4	9	9	13	7	12	6
	20	9	4	7	4	10	10	9	5	11	0	8	8	12	7	11	1
	24	8	6	6	8	9	11	8	7	10	1	7	11	11	9	10	2
2 x 8	12	17	6	13	8	18	8	16	2	19	11	16	2	19	11	19	2
	16	15	2	11	10	16	2	14	0	17	11	14	0	18	1	16	7
	20	13	6	10	7	14	6	12	6	16	0	12	6	16	10	14	10
	24	12	4	9	8	13	2	11	5	14	7	11	5	15	7	13	6
3 x 8	12	22	2	17	4	23	5	20	7	23	5	20	6	23	5	23	5
	16	19	3	15	0	20	7	17	10	21	2	17	9	21	2	21	1
	20	17	2	13	4	18	5	15	11	19	8	15	11	19	8	18	10
	24	15	8	12	3	16	9	14	6	18	6	14	6	18	6	17	2
2 x 10	12	22	1	17	11	23	7	20	6	25	3	21	2	25	3	24	2
	16	19	1	15	6	20	5	17	9	22	8	18	5	22	11	21	0
	20	17	1	13	11	18	4	15	10	20	2	16	5	21	3	18	9
	24	15	7	12	8	16	8	14	6	18	6	15	0	19	9	17	1
3 x 10	12	28	1	22	10	29	7	26	0	29	7	26	10	29	7	29	7
	16	24	2	19	8	26	0	22	7	26	10	23	5	26	10	26	8
	20	21	8	17	8	23	4	20	2	25	0	20	10	25	0	23	10
	24	19	10	16	1	21	2	18	5	23	5	19	1	23	5	21	8
2 x 12	12	26	10	23	1	28	7	24	10	30	5	27	4	30	5	29	4
	16	23	2	20	0	24	10	21	5	27	5	23	7	27	8	25	5
	20	20	8	17	11	22	2	19	2	24	6	21	2	25	9	22	8
	24	18	11	16	4	20	3	17	6	22	5	19	4	24	0	20	9

ROUGH LUMBER

2 x 6	12	14	3	11	2	16	7	14	4	16	11	13	3	17	1	17	0
	16	12	4	9	9	14	4	12	5	14	8	11	6	15	6	14	9
	20	11	1	8	8	12	10	11	1	13	1	10	3	14	5	13	2
	24	10	1	7	11	11	8	10	2	11	11	9	5	13	6	12	0
2 x 8	12	20	8	16	2	22	1	19	1	22	9	19	1	22	9	22	7
	16	17	11	14	0	19	1	16	7	20	8	16	6	20	8	19	7
	20	16	0	12	6	17	1	14	10	18	11	14	9	19	3	17	6
	24	14	7	11	5	15	7	13	6	17	3	13	6	18	1	16	0
3 x 8	12	25	4	19	9	26	1	23	5	26	1	23	5	26	1	26	1
	16	21	11	17	1	23	5	20	3	23	8	20	3	23	8	23	8
	20	19	7	15	4	21	0	18	2	22	0	18	1	22	0	21	5
	24	17	11	14	0	19	2	16	7	20	8	16	6	20	8	19	7
2 x 10	12	25	10	20	11	27	7	23	11	28	5	24	10	28	5	28	3
	16	22	4	18	2	23	11	20	8	25	10	21	5	25	10	24	6
	20	20	0	16	2	21	5	18	6	23	8	19	2	24	0	21	11
	24	18	3	14	10	19	6	16	11	21	7	17	6	22	7	20	0
3 x 10	12	31	8	25	7	32	6	29	4	32	6	30	5	32	6	32	6
	16	27	4	22	3	29	4	25	4	29	7	26	3	29	7	29	7
	20	24	6	19	10	26	3	22	8	27	5	23	6	27	5	26	10
	24	22	5	18	2	23	11	20	9	25	10	21	5	25	10	24	6
2 x 12	12	31	0	26	8	33	2	28	8	34	2	31	7	34	2	34	0
	16	26	10	23	2	28	8	24	10	31	0	27	5	31	0	29	5
	20	24	0	20	8	25	8	22	3	28	5	24	5	28	9	26	3
	24	21	11	18	11	23	5	20	4	25	11	22	4	27	1	24	0

WESTERN HEMLOCK

Table III.—CEILING JOISTS

Nominal size (inches)	Spacing c. to c.	Limited attic storage				No attic storage			
		No. 1 Dimension	No. 2 Dimension	1200–f	900–f	No. 1 Dimension	No. 2 Dimension	1200–f	900–f
	In.	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*
2 x 4	12	7 0	5 4	8 9	8 5	11 0	9 3	11 0	11 0
	16	6 1	4 8	7 11	7 4	10 0	8 0	10 0	10 0
	20	5 5	4 2	7 5	6 7	9 3	7 2	9 3	9 3
	24	4 11	3 9	6 11	6 0	8 8	6 7	8 9	8 9
2 x 6	12	13 0	10 3	13 7	13 1	17 1	17 1	17 1	17 1
	16	11 3	8 11	12 3	11 4	15 8	15 5	15 8	15 8
	20	10 1	7 11	11 6	10 2	14 4	13 9	14 4	14 4
	24	9 3	7 3	10 9	9 3	13 7	12 7	13 7	13 7
2 x 8	12	18 3	14 9	18 3	17 6	22 10	22 10	22 10	22 10
	16	16 4	12 10	16 4	15 2	20 11	20 11	20 11	20 11
	20	14 8	11 5	15 4	13 7	19 1	19 1	19 1	19 1
	24	13 4	10 5	14 4	12 5	18 1	18 1	18 1	18 1
2 x 10	12	22 10	19 5	22 10	22 1	----------	----------	----------	----------
	16	20 8	16 10	20 8	19 3	----------	----------	----------	----------
	20	18 6	15 0	19 4	17 2	----------	----------	----------	----------
	24	16 11	13 9	18 1	15 8	----------	----------	----------	----------

Table IV.—RAFTERS

[Roof slopes greater than 3 in 12. Span is the actual length of the rafter between the plate and the ridge or an intermediate support]

Nominal size (inches)	Spacing c. to c.	No. 1 Dimension		No. 2 Dimension		1200–f		900–f	
		Light roofing	Heavy roofing	Light roofing	Heavy roofing	Light roofing	Heavy roofing	Light roofing	Heavy roofing
	In.	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*
2 x 4	12	8 10	7 10	6 8	6 0	12 3	10 11	10 7	9 5
	16	7 8	6 10	5 10	5 2	10 8	9 5	9 2	8 2
	20	6 10	6 1	5 2	4 8	9 6	8 5	8 3	7 4
	24	6 3	5 7	4 9	4 3	8 8	7 8	7 6	6 8
2 x 6	12	16 4	14 7	12 10	11 5	19 0	16 11	16 5	14 8
	16	14 2	12 7	11 2	9 11	16 6	14 8	14 3	12 8
	20	12 8	11 3	10 0	8 11	14 8	13 1	12 9	11 4
	24	11 7	10 4	9 1	8 1	13 5	12 0	11 8	10 4
2 x 8	12	23 8	21 1	18 6	16 6	25 3	22 7	22 0	19 6
	16	20 6	18 3	16 1	14 3	22 0	19 6	19 0	16 11
	20	18 4	16 4	14 4	12 9	19 8	17 6	17 0	15 2
	24	16 9	14 11	13 1	11 8	17 11	16 0	15 6	13 10
2 x 10	12	30 0	26 9	24 4	21 8	32 1	28 7	27 10	24 9
	16	26 0	23 2	21 1	18 9	27 10	24 8	24 1	21 5
	20	23 3	20 8	18 10	16 9	24 10	22 2	21 6	19 2
	24	21 3	18 11	17 2	15 4	22 8	20 2	19 8	17 6

Light Roofing: Material weighing, in place, 5 pounds or less per square foot.
Heavy Roofing: Material weighing, in place, over 5 pounds per square foot.

SOUTHERN YELLOW PINE

Longleaf

Table 1.—FLOOR JOISTS

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	No. 1 dimension	No. 2 dimension 1050–f	No. 2 dimension
	In.	*Ft. In.*	*Ft. In.*	*Ft. In.*
2 x 6	12	11 3	11 3	9 1
	16	10 2	10 2	7 11
	20	9 6	9 6	7 1
	24	8 11	8 11	6 5
2 x 8	12	15 0	15 0	11 10
	16	13 8	13 8	10 4
	20	12 8	12 8	9 2
	24	11 11	11 11	8 4
3 x 8	12	17 8	17 8	15 1
	16	16 0	16 0	13 1
	20	14 11	14 11	11 8
	24	14 0	14 0	10 8
2 x 10	12	19 0	19 0	15 5
	16	17 3	17 3	13 4
	20	16 1	16 1	11 11
	24	15 1	15 1	10 11
3 x 10	12	22 4	22 4	19 8
	16	20 3	20 3	17 0
	20	18 10	18 10	15 2
	24	17 9	17 9	13 11
2 x 12	12	23 0	23 0	18 9
	16	20 10	20 10	16 2
	20	19 5	19 5	14 6
	24	18 3	18 3	13 3
ROUGH LUMBER				
2 x 6	12	12 10	12 10	10 10
	16	11 8	11 8	9 5
	20	10 10	10 10	8 4
	24	10 3	10 3	7 8
2 x 8	12	17 2	17 2	14 0
	16	15 7	15 7	12 2
	20	14 6	14 6	10 10
	24	13 7	13 7	9 11
3 x 8	12	19 8	19 8	17 2
	16	17 10	17 10	14 11
	20	16 7	16 7	13 4
	24	15 7	15 7	12 3
2 x 10	12	21 6	21 6	18 0
	16	19 6	19 6	15 7
	20	18 1	18 1	14 0
	24	17 1	17 1	12 9
3 x 10	12	24 7	24 7	22 0
	16	22 4	22 4	19 1
	20	20 8	20 8	17 1
	24	19 6	19 6	15 7
2 x 12	12	25 9	25 9	21 7
	16	23 5	23 5	18 9
	20	21 8	21 8	16 9
	24	20 5	20 5	15 5

SOUTHERN YELLOW PINE

Longleaf

Table II.—FLAT ROOF JOISTS

[Roof slopes 3 in 12 and less. Span is the horizontal distance between supports]

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	Supporting finished ceiling						Not supporting finished ceiling					
		No. 1 Dimension		No. 2 Dimension 1050–f		No. 2 Dimension		No. 1 Dimension		No. 2 Dimension 1050–f		No. 2 Dimension	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 6	12	15	1	13	1	9	4	15	7	15	6	11	1
	16	13	1	11	4	8	1	14	2	13	5	9	7
	20	11	8	10	2	7	3	13	2	12	0	8	7
	24	10	8	9	3	6	8	12	5	10	11	7	10
2 x 8	12	20	2	17	6	12	2	20	10	20	8	14	5
	16	17	6	15	2	10	7	18	11	17	11	12	6
	20	15	7	13	6	9	5	17	7	16	0	11	2
	24	14	3	12	4	8	7	16	6	14	7	10	2
3 x 8	12	24	5	22	2	15	6	24	5	24	5	18	4
	16	22	2	19	3	13	5	22	2	22	2	15	11
	20	19	9	17	2	12	0	20	7	20	4	14	2
	24	18	0	15	8	10	11	19	5	18	7	12	11
2 x 10	12	25	6	22	1	15	10	26	4	26	2	18	9
	16	22	1	19	1	13	9	24	0	22	8	16	3
	20	19	9	17	1	12	3	22	4	20	2	14	6
	24	18	1	15	7	11	3	10	11	18	6	13	3
3 x 10	12	31	0	28	1	20	2	31	0	31	0	23	10
	16	28	1	24	2	17	6	28	1	28	1	20	8
	20	25	1	21	8	15	7	26	1	25	7	18	5
	24	23	0	19	10	14	4	24	7	23	6	16	10
2 x 12	12	30	11	26	10	19	2	31	10	31	8	22	9
	16	26	10	23	2	16	8	29	0	27	5	19	8
	20	24	0	20	8	14	11	26	10	24	6	17	7
	24	21	10	18	11	13	7	25	4	22	5	16	1

ROUGH LUMBER

2 x 6	12	17	10	15	6	11	1	17	10	17	10	13	2
	16	15	6	13	5	9	8	16	2	15	11	11	5
	20	13	10	12	0	8	7	15	1	14	2	10	2
	24	12	8	11	0	7	10	14	2	13	0	9	4
2 x 8	12	23	9	20	8	14	5	23	9	23	9	17	0
	16	20	8	17	11	12	6	21	7	21	2	14	9
	20	18	6	16	0	11	2	20	1	18	11	13	2
	24	16	10	14	7	10	2	18	11	17	3	12	0
3 x 8	12	27	2	25	4	17	8	27	2	27	2	20	10
	16	24	9	21	11	15	3	24	9	24	9	18	1
	20	22	7	19	7	13	8	23	0	23	0	16	2
	24	20	7	17	11	12	6	21	7	21	2	14	9
2 x 10	12	29	9	25	10	18	6	29	9	29	9	21	11
	16	25	10	22	4	16	0	27	0	26	6	19	0
	20	23	1	20	0	14	4	25	1	23	8	17	0
	24	21	1	18	3	13	1	23	7	21	7	15	6
3 x 10	12	34	2	31	8	22	8	34	2	34	2	26	10
	16	31	0	27	4	19	7	31	0	31	0	23	3
	20	28	4	24	6	17	7	28	10	28	10	20	10
	24	25	10	22	5	16	0	27	0	26	5	19	0
2 x 12	12	35	8	31	0	22	3	35	8	35	8	26	4
	16	31	0	26	10	19	3	32	6	31	10	22	10
	20	27	8	24	0	17	3	30	1	28	5	20	5
	24	25	3	21	11	15	8	28	4	25	11	18	7

SOUTHERN YELLOW PINE

Longleaf

Table III.—CEILING JOISTS

Nominal size (inches)	Spacing c. to c.	Limited attic storage						No attic storage					
		No. 1 dimension		No. 2 dimension 1050–f		No. 2 dimension		No. 1 dimension		No. 2 dimension 1050–f		No. 2 dimension	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 4	12	9	2	9	2	6	3	11	6	11	6	10	9
	16	8	3	7	11	5	5	10	6	10	6	9	4
	20	7	9	7	1	4	10	9	8	9	8	8	4
	24	7	3	6	5	4	5	9	1	9	1	7	8
2 x 6	12	14	2	14	2	10	2	17	10	17	10	17	7
	16	12	10	12	3	8	10	16	5	16	5	15	3
	20	12	0	11	0	7	10	15	0	15	0	13	8
	24	11	3	10	0	7	2	14	2	14	2	12	5
2 x 8	12	18	11	18	11	13	2	23	10	23	10	22	10
	16	17	1	16	5	11	5	21	10	21	10	19	10
	20	16	0	14	8	10	3	20	0	20	0	17	9
	24	15	0	13	4	9	4	18	11	18	11	16	2
2 x 10	12	23	11	23	11	17	2	----		----		----	
	16	21	8	20	9	14	10	----		----		----	
	20	20	3	18	6	13	4	----		----		----	
	24	19	0	16	11	12	1	----		----		----	

Table IV.—RAFTERS

[Roof slopes greater than 3 in 12. Span is the actual length of the rafter between the plate and the ridge or an intermediate support]

Nominal size (inches)	Spacing c. to c.	No. 1 dimension				No. 2 dimension 1050-f				No. 2 dimension			
		Light roofing		Heavy roofing		Light roofing		Heavy roofing		Light roofing		Heavy roofing	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 4	12	13	3	11	9	11	5	10	2	7	10	7	0
	16	11	6	10	2	9	11	8	10	6	9	6	1
	20	10	3	9	2	8	10	7	11	6	1	5	5
	24	9	4	8	4	8	1	7	3	5	6	4	11
2 x 6	12	20	6	18	3	17	9	15	10	12	9	11	4
	16	17	9	15	10	15	5	13	8	11	0	9	10
	20	15	11	14	2	13	9	12	3	9	10	8	10
	24	14	6	12	11	12	7	11	2	9	0	8	0
2 x 8	12	27	4	24	4	23	8	21	1	16	6	14	8
	16	23	9	21	1	20	6	18	3	14	4	12	9
	20	21	2	18	11	18	4	16	4	12	10	11	5
	24	19	4	17	3	16	9	14	11	11	8	10	5
2 x 10	12	34	7	30	10	30	0	26	9	21	6	19	2
	16	30	0	26	8	26	0	23	2	18	8	16	7
	20	26	10	23	10	23	3	20	8	16	8	14	10
	24	24	6	21	10	21	3	18	11	15	2	13	6

Light Roofing: Material weighing, in place, 5 pounds or less per square foot.
Heavy Roofing: Material weighing, in place, over 5 pounds per square foot.

SOUTHERN YELLOW PINE

Shortleaf

Table 1.—FLOOR JOISTS

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	No. 1 Dimension	No. 2 Dimension Dense 1050-f	No. 2 Dimension Medium Grain 900-f	No. 2 Dimension
	In.	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*
2 x 6	12	11 3	11 3	11 3	8 6
	16	10 2	10 2	10 2	7 3
	20	9 6	9 6	9 2	6 6
	24	8 11	8 11	8 4	6 0
2 x 8	12	15 0	15 0	15 0	11 0
	16	13 8	13 8	13 8	9 7
	20	12 8	12 8	12 2	8 7
	24	11 11	11 11	11 1	7 10
3 x 8	12	17 8	17 8	17 8	14 0
	16	16 0	16 0	16 0	12 2
	20	14 11	14 11	14 11	10 10
	24	14 0	14 0	14 0	9 10
2 x 10	12	19 0	19 0	19 0	14 3
	16	17 3	17 3	17 3	12 5
	20	16 1	16 1	15 5	11 0
	24	15 1	15 1	14 2	10 3
3 x 10	12	22 4	22 4	22 4	18 1
	16	20 3	20 3	20 3	15 8
	20	18 10	18 10	18 10	14 1
	24	17 9	17 9	17 9	12 10
2 x 12	12	23 0	23 0	23 0	17 3
	16	20 10	20 10	20 10	15 0
	20	19 5	19 5	18 8	13 5
	24	18 3	18 3	17 1	12 3
ROUGH LUMBER					
2 x 6	12	12 10	12 10	12 10	10 1
	16	11 8	11 8	11 8	8 8
	20	10 10	10 10	10 10	7 9
	24	10 3	10 3	9 10	7 1
2 x 8	12	17 2	17 2	17 2	13 1
	16	15 7	15 7	15 7	11 4
	20	14 6	14 6	14 5	10 0
	24	13 7	13 7	13 3	9 2
3 x 8	12	19 8	19 8	19 8	15 11
	16	17 10	17 10	17 10	13 10
	20	16 7	16 7	16 7	12 5
	24	15 7	15 7	15 7	11 4
2 x 10	12	21 6	21 6	21 6	16 7
	16	19 6	19 6	19 6	14 5
	20	18 1	18 1	18 0	12 10
	24	17 1	17 1	16 6	11 9
3 x 10	12	24 7	24 7	24 7	20 5
	16	22 4	22 4	22 4	17 8
	20	20 8	20 8	20 8	15 10
	24	19 6	19 6	19 6	14 5
2 x 12	12	25 9	25 9	25 9	19 11
	16	23 5	23 5	23 5	17 6
	20	21 8	21 8	21 7	15 5
	24	20 5	20 5	19 9	14 2

SOUTHERN YELLOW PINE

Shortleaf

Table II.—FLAT ROOF JOISTS

[Roof slopes 3 in 12 and less. Span is the horizontal distance between supports

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	Supporting finished ceiling				Not supporting finished ceiling			
		No. 1 Dimension	No. 2 Dimension Dense 1050–f	No. 2 Dimension Medium Grain 900–f	No. 2 Dimension	No. 1 Dimension	No. 2 Dimension Dense 1050–f	No. 2 Dimension Medium Grain 900–f	No. 2 Dimension
	In.	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*
2 x 6	12	14 0	13 1	12 1	8 8	15 7	15 6	14 4	10 3
	16	12 1	11 4	10 6	7 6	14 2	13 5	12 6	8 10
	20	10 10	10 2	9 5	6 9	12 10	12 0	11 1	7 11
	24	9 11	9 3	8 7	6 2	11 9	10 11	10 2	7 3
2 x 8	12	18 8	17 6	16 2	11 4	20 10	20 8	19 2	13 5
	16	16 2	15 2	14 0	9 10	18 11	17 11	16 7	11 7
	20	14 6	13 6	12 6	8 9	17 2	16 0	14 10	10 4
	24	13 2	12 4	11 5	8 0	15 7	14 7	13 6	9 6
3 x 8	12	23 9	22 2	20 7	14 5	24 5	24 5	24 4	17 0
	16	20 7	19 3	17 10	12 5	22 2	22 2	21 1	14 9
	20	18 5	17 2	15 11	11 2	20 7	20 4	18 10	13 2
	24	16 9	15 8	14 6	10 2	19 5	18 7	17 2	12 0
2 x 10	12	23 7	22 1	20 6	14 8	26 4	26 2	24 2	17 4
	16	20 5	19 1	17 9	12 8	24 0	22 8	21 0	15 0
	20	18 4	17 1	15 10	11 4	21 8	20 2	18 9	13 5
	24	16 8	15 7	14 6	10 4	19 9	18 6	17 1	12 3
3 x 10	12	30 0	28 1	26 0	18 8	31 0	31 0	30 8	22 0
	16	26 0	24 2	22 7	16 1	28 1	28 1	26 8	19 1
	20	23 4	21 8	20 2	14 5	26 1	25 7	23 10	17 1
	24	21 2	19 10	18 5	13 1	24 7	23 6	21 8	15 7
2 x 12	12	28 7	26 10	24 10	17 9	31 10	31 8	29 4	21 0
	16	24 10	23 2	21 5	15 4	29 0	27 5	25 5	18 2
	20	22 2	20 8	19 2	13 9	26 2	24 6	22 8	16 3
	24	20 3	18 11	17 6	12 7	24 0	22 5	20 9	14 10
ROUGH LUMBER									
2 x 6	12	16 7	15 6	14 4	10 3	17 10	17 10	17 0	12 2
	16	14 4	13 5	12 5	8 11	16 2	15 11	14 9	10 6
	20	12 10	12 0	11 1	7 11	15 1	14 2	13 2	9 5
	24	11 8	11 0	10 2	7 3	13 10	13 0	12 0	8 7
2 x 8	12	22 1	20 8	19 1	13 5	23 9	23 9	22 7	15 10
	16	19 1	17 11	16 7	11 7	21 7	21 2	19 7	13 9
	20	17 1	16 0	14 10	10 4	20 1	18 11	17 6	12 3
	24	15 7	14 7	13 6	9 6	18 6	17 3	16 0	11 2
3 x 8	12	27 0	25 4	23 5	16 5	27 2	27 2	27 2	19 5
	16	23 5	21 11	20 3	14 2	24 9	24 9	24 0	16 10
	20	21 0	19 7	18 2	12 8	23 0	23 0	21 5	15 0
	24	19 2	17 11	16 7	11 7	21 7	21 2	19 7	13 8
2 x 10	12	27 7	25 10	23 11	17 1	29 9	29 9	28 3	20 2
	16	23 11	22 4	20 8	14 10	27 0	26 6	24 6	17 6
	20	21 5	20 0	18 6	13 3	25 1	23 8	21 11	15 8
	24	19 6	18 3	16 11	12 1	23 1	21 7	20 0	14 4
3 x 10	12	33 10	31 8	29 4	20 11	34 2	34 2	34 2	24 8
	16	29 4	27 4	25 4	18 2	31 0	31 0	30 0	21 5
	20	26 3	24 6	22 8	16 3	28 10	28 10	26 10	19 2
	24	23 11	22 5	20 9	14 10	27 0	26 5	24 6	17 7
2 x 12	12	33 2	31 0	28 8	20 6	35 8	35 8	34 0	24 3
	16	28 8	26 10	24 10	17 9	32 6	31 10	29 5	21 0
	20	25 8	24 0	22 3	15 10	30 1	28 5	26 3	18 10
	24	23 5	21 11	20 4	14 6	27 9	25 11	24 0	17 2

SOUTHERN YELLOW PINE

Shortleaf

Table III.—CEILING JOISTS

Nominal size (inches)	Spacing c. to c.	Limited attic storage								No attic storage							
		No. 1 Dimension		No. 2 Dimension Dense 1050–f		No. 2 Dimension Medium Grain 900–f		No. 2 Dimension		No. 1 Dimension		No. 2 Dimension Dense 1050–f		No. 2 Dimension Medium Grain 900–f		No. 2 Dimension	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 4	12	9	2	9	2	8	5	5	9	11	6	11	6	11	6	10	0
	16	8	3	7	11	7	4	5	0	10	6	10	6	10	6	8	8
	20	7	7	7	1	6	7	4	6	9	8	9	8	9	8	7	9
	24	7	0	6	5	6	0	4	1	9	1	9	1	9	1	7	1
2 x 6	12	14	2	14	2	13	1	9	4	17	10	17	10	17	10	16	3
	16	12	10	12	3	11	4	8	1	16	5	16	5	16	5	14	1
	20	11	9	11	0	10	2	7	3	15	0	15	0	15	0	12	7
	24	10	9	10	0	9	3	6	8	14	2	14	2	14	2	11	6
2 x 8	12	18	11	18	11	17	6	12	3	23	10	23	10	23	10	21	2
	16	17	1	16	5	15	2	10	7	21	10	21	10	21	10	18	4
	20	15	8	14	8	13	7	9	5	20	0	20	0	20	0	16	5
	24	14	4	13	4	12	5	8	8	18	11	18	11	18	11	14	11
2 x 10	12	23	11	23	11	22	1	15	10	----		----		----		----	
	16	21	8	20	9	19	3	13	9	----		----		----		----	
	20	19	10	18	6	17	2	12	3	----		----		----		----	
	24	18	1	16	11	15	8	11	2	----		----		----		----	

Table IV.—RAFTERS

[Roof slopes greater than 3 in 12. Span is the actual length of the rafter between the plate and the ridge or an intermediate support]

Nominal size (inches)	Spacing c. to c.	No. 1 Dimension		No. 2 Dimension Dense 1050–f		No. 2 Dimension Medium Grain 900–f		No. 2 Dimension	
		Light roofing	Heavy roofing	Light roofing	Heavy roofing	Light roofing	Heavy roofing	Light roofing	Heavy roofing
	In.	*Ft.* *In.*	*Ft.* *In.*	*Ft.* *In.*	*Ft.* *In.*	*Ft.* *In.*	*Ft.* *In.*	*Ft.* *In.*	*Ft.* *In.*
2 x 4	12	12 3	10 11	11 5	10 2	10 7	9 5	7 3	6 5
	16	10 8	9 5	9 11	8 10	9 2	8 2	6 4	5 7
	20	9 6	8 5	8 10	7 11	8 3	7 4	5 8	5 0
	24	8 8	7 8	8 1	7 3	7 6	6 8	5 2	4 7
2 x 6	12	19 0	16 11	17 9	15 10	16 5	14 8	11 9	10 5
	16	16 6	14 8	15 5	13 8	14 3	12 8	10 2	9 1
	20	14 8	13 1	13 9	12 3	12 9	11 4	9 1	8 1
	24	13 5	12 0	12 7	11 2	11 8	10 4	8 4	7 5
2 x 8	12	25 3	22 7	23 8	21 1	22 0	19 6	15 4	13 8
	16	22 0	19 6	20 6	18 3	19 0	16 11	13 4	11 10
	20	19 8	17 6	18 4	16 4	17 0	15 2	11 11	10 7
	24	17 11	16 0	16 9	14 11	15 6	13 10	10 10	9 8
2 x 10	12	32 1	28 7	30 0	26 9	27 10	24 9	19 10	17 8
	16	27 10	24 8	26 0	23 2	24 1	21 5	17 3	15 4
	20	24 10	22 2	23 3	20 8	21 6	19 2	15 4	13 8
	24	22 8	20 2	21 3	18 11	19 8	17 6	14 1	12 6

Light Roofing: Material weighing, in place, 5 pounds or less per square foot.
Heavy Roofing: Material weighing, in place, over 5 pounds per square foot.

EASTERN SPRUCE

N. E. L. M. A.

Table I.—FLOOR JOISTS

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	No. 1 Merchantable	Nominal size (inches)	Spacing c. to c.	No. 1 Merchantable
	In.	*Ft. In.*		*In.*	*Ft. In.*
2 x 6	12	10 3	2 x 10	12	17 3
	16	9 4		16	15 8
	20	8 5		20	14 7
	24	7 8		24	13 9
2 x 8	12	13 8	3 x 10	12	20 2
	16	12 5		16	18 5
	20	11 6		20	17 2
	24	10 10		24	16 1
3 x 8	12	16 0	2 x 12	12	20 10
	16	14 7		16	19 0
	20	13 7		20	17 8
	24	12 9		24	16 7
ROUGH LUMBER					
2 x 6	12	11 8	2 x 10	12	19 6
	16	10 8		16	17 7
	20	9 10		20	16 5
	24	9 0		24	15 6
2 x 8	12	15 7	3 x 10	12	22 4
	16	14 2		16	20 3
	20	13 2		20	18 10
	24	12 5		24	17 9
3 x 8	12	17 10	2 x 12	12	23 5
	16	16 3		16	21 2
	20	15 1		20	19 9
	24	14 2		24	18 7

Table II.—FLAT ROOF JOISTS

[Roof slopes 3 in 12 and less. Span is the horizontal distance between supports]

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	No. 1 Merchantable		Nominal size (inches)	Spacing c. to c.	No. 1 Merchantable	
		Supporting finished ceiling	Not supporting finished ceiling			Supporting finished ceiling	Not supporting finished ceiling
	In.	*Ft. In.*	*Ft. In.*		*In.*	*Ft. In.*	*Ft. In.*
2 x 6	12	11 1	13 1	2 x 10	12	20 4	24 0
	16	9 7	11 4		16	17 7	20 10
	20	8 7	10 2		20	15 9	18 8
	24	7 10	9 3		24	14 5	17 0
2 x 8	12	16 1	18 11	3 x 10	12	25 10	28 1
	16	13 11	16 6		16	22 4	25 7
	20	12 5	14 9		20	20 0	23 8
	24	11 5	13 5		24	18 4	21 7
3 x 8	12	20 5	22 2	2 x 12	12	26 5	29 0
	16	17 8	20 2		16	22 10	26 5
	20	15 10	18 8		20	20 5	24 2
	24	14 5	17 1		24	18 8	22 1
ROUGH LUMBER							
2 x 6	12	13 1	15 6	2 x 10	12	23 10	27 0
	16	11 4	13 5		16	20 7	24 3
	20	10 2	12 1		20	18 5	21 10
	24	9 3	11 0		24	16 10	19 11
2 x 8	12	19 0	21 7	3 x 10	12	29 2	31 0
	16	16 5	19 6		16	25 2	28 1
	20	14 8	17 5		20	22 7	26 1
	24	13 5	15 11		24	20 8	24 5
3 x 8	12	23 4	24 9	2 x 12	12	30 7	32 5
	16	20 2	22 5		16	26 5	29 5
	20	18 1	20 10		20	23 7	27 5
	24	16 6	19 6		24	21 7	25 7

EASTERN SPRUCE

N. E. L. M. A.

Table III.—CEILING JOISTS

Nominal size (inches)	Spacing c. to c.	No. 1 Merchantable		Nominal size (inches)	Spacing c. to c.	No. 1 Merchantable	
		Limited attic storage	No attic storage			Limited attic storage	No attic storage
	In.	*Ft. In.*	*Ft. In.*		*In.*	*Ft. In.*	*Ft. In.*
2 x 4	12	6 7	10 5	2 x 8	12	17 2	21 7
	16	5 8	9 6		16	15 1	19 10
	20	5 1	8 9		20	13 6	18 1
	24	4 8	8 0		24	12 4	17 2
2 x 6	12	11 11	16 3	2 x 10	12	21 9	----------
	16	10 4	14 11		16	19 1	----------
	20	9 3	13 7		20	17 0	----------
	24	8 5	12 11		24	15 7	----------

Table IV.—RAFTERS

[Roof slopes greater than 3 in 12. Span is the actual length of the rafter between the plate and the ridge or an intermediate support]

Nominal size (inches)	Spacing c. to c.	No. 1 Merchantable		Nominal size (inches)	Spacing c. to c.	No. 1 Merchantable	
		Light roofing	Heavy roofing			Light roofing	Heavy roofing
	In.	*Ft. In.*	*Ft. In.*		*In.*	*Ft. In.*	*Ft. In.*
2 x 4	12	8 3	7 4	2 x 8	12	21 10	19 5
	16	7 2	6 4		16	18 11	16 10
	20	6 4	5 8		20	16 11	15 1
	24	5 10	5 2		24	15 5	13 9
2 x 6	12	15 0	13 4	2 x 10	12	27 8	24 7
	16	13 0	11 7		16	24 0	21 3
	20	11 8	10 4		20	21 5	19 0
	24	10 8	9 5		24	19 7	17 5

Light roofing: Material weighing, in place, 5 pounds or less per square foot.
Heavy Roofing: Material weighing, in place, over 5 pounds per square foot.

EASTERN HEMLOCK

Table I.—FLOOR JOISTS

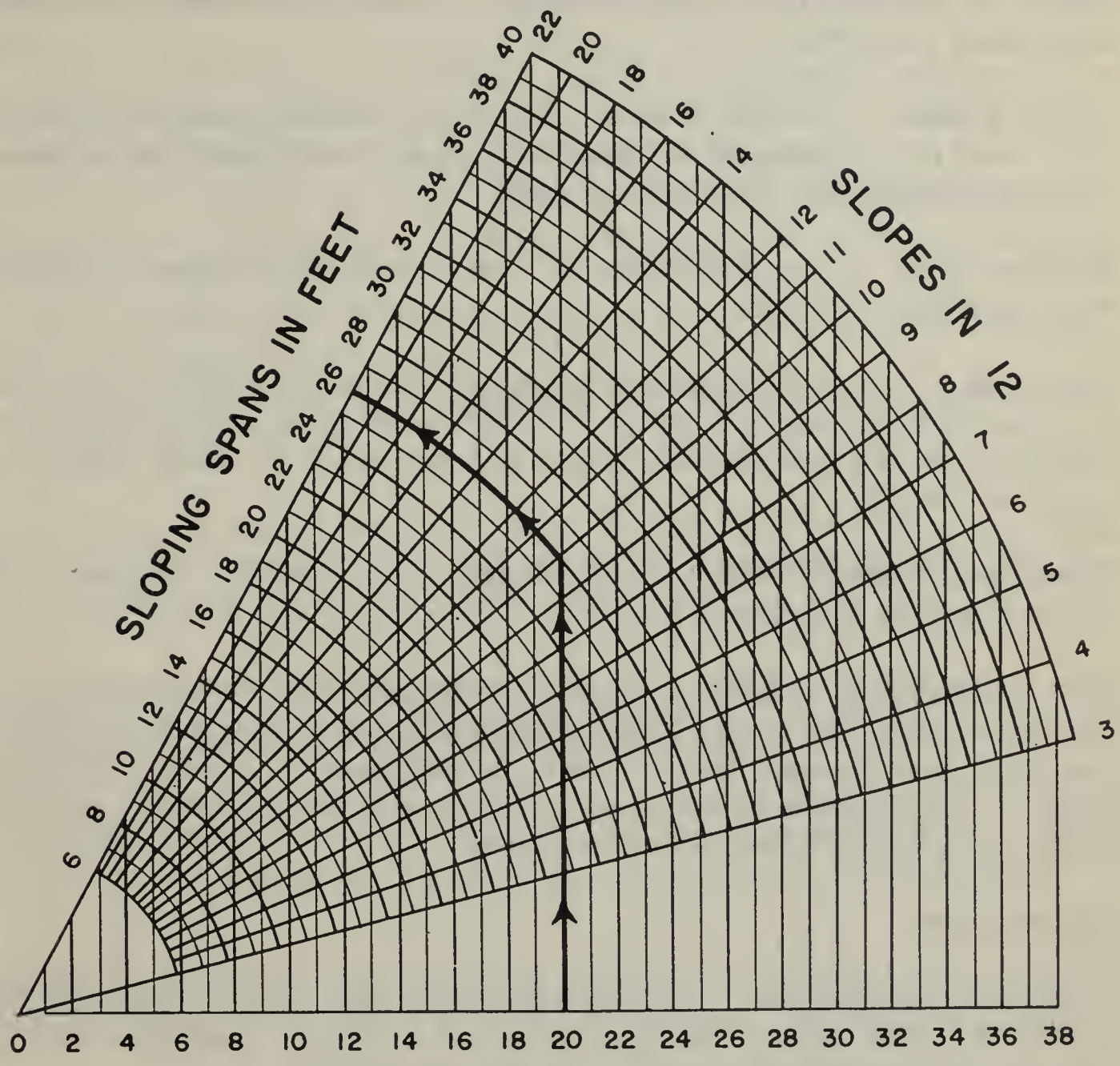
DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	No. 1 Common Dimension	1000 S. G.	900 S. G.	800 S. G.
	In.	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*
2 x 6	12	9 11	9 11	9 11	9 11
	16	8 9	9 0	9 0	9 0
	20	7 10	8 5	8 5	8 5
	24	7 2	7 11	7 11	7 11
2 x 8	12	13 3	13 3	13 3	13 3
	16	12 0	12 0	12 0	12 0
	20	10 9	11 2	11 2	11 2
	24	9 10	10 6	10 6	10 6
3 x 8	12	15 7	15 7	15 7	15 7
	16	14 2	14 2	14 2	14 2
	20	13 2	13 2	13 2	13 2
	24	12 4	12 4	12 4	12 4
2 x 10	12	16 9	16 9	16 9	16 9
	16	15 2	15 2	15 2	15 2
	20	14 2	14 2	14 2	14 2
	24	13 4	13 4	13 4	13 4
3 x 10	12	19 8	19 8	19 8	19 8
	16	17 10	17 10	17 10	17 10
	20	16 8	16 8	16 8	16 8
	24	15 8	15 8	15 8	15 8
2 x 12	12	20 3	20 3	20 3	20 3
	16	18 5	18 5	18 5	18 5
	20	17 2	17 2	17 2	17 2
	24	16 1	16 1	16 1	16 1

ROUGH LUMBER

2 x 6	12	11 5	11 5	11 5	11 5
	16	10 4	10 4	10 4	10 4
	20	9 4	9 7	9 7	9 7
	24	8 6	9 0	9 0	9 0
2 x 8	12	15 2	15 2	15 2	15 2
	16	13 9	13 9	13 9	13 9
	20	12 8	12 9	12 9	12 9
	24	11 7	12 0	12 0	12 0
3 x 8	12	17 4	17 4	17 4	17 4
	16	15 9	15 9	15 9	15 9
	20	14 8	14 8	14 8	14 8
	24	13 9	13 9	13 9	13 9
2 x 10	12	18 11	18 11	18 11	18 11
	16	17 2	17 2	17 2	17 2
	20	16 0	16 0	16 0	16 0
	24	15 0	15 0	15 0	15 0
3 x 10	12	21 8	21 8	21 8	21 8
	16	19 9	19 9	19 9	19 9
	20	18 3	18 3	18 3	18 3
	24	17 2	17 2	17 2	17 2
2 x 12	12	22 9	22 9	22 9	22 9
	16	20 7	20 7	20 7	20 7
	20	19 2	19 2	19 2	19 2
	24	18 0	18 0	18 0	18 0

RAFTER SPAN CONVERSION DIAGRAM



To find the rafter span when its horizontal span and slope are known, follow the vertical line from the horizontal span to its intersection with the radial line of the slope. From the intersection follow the curve line to the sloping span. The diagram also may be used to determine the horizontal span when the sloping span and slope are known, or to determine the slope when the sloping and horizontal spans are known.

Example: For a horizontal span of 20 feet and a slope of 10 in 12, the sloping span of the rafter is read directly from the diagram as 26 feet.

APPENDIX B

DEFINITIONS

Alley: A narrow service way providing a secondary public means of access to abutting properties.

Building Area: The total of areas taken on a horizontal plane at the mean grade level of the principal buildings and all accessory buildings, exclusive of uncovered porches, terraces and steps.

Building Line: A line established by law or agreement beyond which a building shall not extend.

Cesspool: A covered pit with open-jointed lining into which raw sewage is discharged, the liquid portion of which is disposed of by seepage or leaching into the surrounding porous soil, the solids or sludge being retained in the pit.

Community System (Water or Sewerage): Any system which is not a public system or an individual system.

Note: Such systems usually serve one or more residential developments. It should be noted that a community system as herein defined may include systems defined by state law as public systems since state laws frequently define a public system as one serving a given number of families (possibly 10 or 25) regardless of ownership or control.

Construction:

Existing Construction: Construction which was completed prior to the date of the submission of the application for mortgage insurance, regardless of any contemplated repairs, alterations or additions.

Proposed Construction: Construction which is contemplated or partially built on the date of submission of the application for mortgage insurance. The term "proposed construction" does not refer to contemplated repairs, alterations or additions to existing construction.

Court: An open, unoccupied space bounded on two or more sides by the exterior walls of a building or by exterior walls and lot lines.

Inner Court: A court enclosed on all sides by exterior walls of a building or by exterior walls and lot lines on which walls are allowable.

Outer Court: A court enclosed on not more than three sides by exterior walls of a building or by exterior walls and lot lines on which walls are allowable, with one side or end open to a street, driveway, alley or yard.

Coverage: That percentage of the plot area covered by the building area.

Driveway: A private way for the use of vehicles and pedestrians.

Dry Well: A covered pit with open-jointed lining through which drainage from roofs, basement floors, or areaways may seep or leach into the surrounding porous soil.

Dwelling: A building designed or used as the living quarters for one or more families.

Detached Dwelling: A dwelling which is completely surrounded by permanent open spaces.

End Row Dwelling: Same as Semidetached Dwelling.

Multifamily Dwelling: A dwelling on one plot containing separate living units for two or more families; sometimes having joint services or facilities or both.

Row Dwelling: A dwelling the walls on two sides of which are party or lot line walls.

Semidetached Dwelling: A dwelling one side wall of which is a party or lot line wall.

Easement: A vested or acquired right to use land, other than as a tenant, for a specific purpose; such right being held by someone other than the owner who holds title to the land.

Family: One or more persons living, sleeping, cooking and eating on the same premises as occupants of one living unit.

Individual System (Water or Sewerage): A system serving a single property containing not more than 4 living units.

Living Facilities: Those provisions for living, sleeping, eating, cooking and sanitation, ordinarily considered as part of a permanent abode.

Living Unit: A dwelling or portion thereof, providing complete living facilities for one family, including permanently installed equipment for cooking, or provisions for the same, and including rooms for living, sleeping and eating.

Lot: A parcel of land in one ownership that is described by reference to a recorded plat or by metes and bounds.

Corner Lot: A lot abutting upon two or more streets at their intersection.

Interior Lot: A lot bounded by a street on one side only.

Lot Line: A line bounding the lot as described in the title to the property.

Definitions. *Continued.*

Plat: A map, plan or chart of a city, town, section or subdivision, indicating the location and boundaries of individual properties.

Plot: A parcel of land consisting of one or more lots or portions thereof which is described by reference to a recorded plat or by metes and bounds.

Property: A lot or plot with any buildings or other improvements located thereon.

Property Line: A recorded boundary of a plot.

Public System (Water or Sewerage): A system which is owned and operated by a local governmental authority or by an established public utility company which is adequately controlled by a governmental authority.

Note: Such systems are usually existing systems serving a municipality, a township, an urban county, or a water or sewer district established and directly controlled under the laws of a state.

Required Window: A window which provides all or part of the required natural light and ventilation under these requirements.

Rooms:

Habitable Room: A room designed to be used for living, sleeping, eating, or cooking, excluding bathrooms, toilet compartments, closets, halls, storage and similar spaces.

Utility Room: A room, other than a habitable room, designed or used for laundry or heating equipment or for other related purposes.

Seepage Pit: A covered pit with open-jointed lining through which septic tank or cesspool effluent or laundry wastes may seep or leach into the surrounding porous soil.

Septic Tank: A covered watertight sewage settling tank intended to retain the solids in immediate contact with the sewage flowing through the tank for a sufficient period to secure satisfactory decomposition of settled solids by bacterial action.

Shall: Indicates that which is required.

Should: Indicates that which is recommended but not required.

Street: A way which affords principal means of access to abutting properties.

Wall:

Party Wall: A wall, used jointly by two parties under easement agreement, erected upon a line separating two parcels of land each of which is a separate real estate entity.

Lot Line Wall: A wall, used only by the party upon whose lot the wall is located, erected at a line separating two parcels of land each of which is a separate real estate entity.

Way: A street, alley, or other thoroughfare or easement permanently established for passage of persons or vehicles.

Yard: An open, unoccupied space on the same lot with a building, between the lot line and the extreme front, rear or side wall of the building.

Front Yard: A yard cross the full width of the lot, extending from the extreme front line of the building to the front lot line.

Rear Yard: A yard across the full width of the lot, extending from the extreme rear line of the building to the rear lot line.

Side Yard: A yard between the extreme side line of the building and the adjacent side lot line, extending from the front yard to the rear yard.

APPENDIX C

REFERENCE STANDARDS

Building Materials and Equipment

The following publications contain recognized Standards which will be used as a guide in determining the acceptability of materials and equipment, except in cases where these Minimum Construction Requirements contain specific provisions which are in conflict with any of the Standards (latest edition).

Abbreviation	*Name and Address of Organization referred to:*
A. C. I.	American Concrete Institute, 7400 Second Boulevard, Detroit, Michigan
A. G. A.	American Gas Association, 420 Lexington Avenue, New York City
A. I. S. C.	American Institute of Steel Construction, New York City
A. S. H. & V. E.	American Society of Heating & Ventilating Engineers, 51 Madison Avenue, New York City
A. S. M. E.	American Society of Mechanical Engineers, 29 West 39th Street, New York City
A. S. T. M.	American Society for Testing Materials, 206 S. Broad Street, Philadelphia, Pennsylvania
A. W. P. A.	American Wood Preservers' Association, 1427 Eye Street, N.W. Washington, D. C.
B. M. S.	Building Materials and Structures, U. S. Department of Commerce, Superintendent of Documents, Washington, D. C.
C. S.	Commercial Standards, U. S. Department of Commerce, Superintendent of Documents, Washington, D. C.
F. S.	Federal Specifications, U. S. Department of Commerce, Superintendent of Documents, Washington, D. C.
H. P. & A. C. C. N. A.	Heating, Piping & Air Conditioning Contractors National Association, 1250 Sixth Avenue, New York City
I. B. R. M.	Institute of Boiler and Radiator Manufacturers, 60 East 42nd Street, New York City

Abbreviation	*Name and Address of Organization referred to:*
N. B. F. U.	National Board of Fire Underwriters, 85 Johns Street, New York City
N. W. A. H. & A. C. A.	National Warm Air Heating & Air Conditioning Association, 145 Public Square, Cleveland, Ohio
N. F. H. W. T. M. A.	Non-Ferrous Hot Water Tank Manufacturers Association, 75 Federal Street, Boston, Massachusetts
S. P. R.	Simplified Practice Recommendations, U. S. Department of Commerce, Superintendent of Documents, Washington, D. C.
S. B. I.	Steel Boiler Institute, 366 Madison Avenue, New York City
T. S.	Tentative Commercial Standards, U. S. Department of Commerce, Superintendent of Documents, Washington, D. C.
U. L.	Underwriters' Laboratories, Inc., 207 E. Ohio Street, Chicago, Illinois

Material	*Specification Number or Volume Including Specification*
Aggregates, concrete	F. S.–SS–A–281a
	A. S. T. M.–C–33
lightweight	A. S. T. M.–C–130
masonry mortar	A. S. T. M.–C–144
Brick, building, clay or shale	F. S.–SS–B–656
	A. S. T. M.–C–62
concrete	F. S.–SS–B–663
	A. S. T. M.–C–55
sand lime	F. S.–SS–B–681
	A. S. T. M.–C–73
fire	F. S.–HH–B–671b
	A. S. T. M.–C–27
Building paper, see Paper.	
Built-up roofs, materials for	U. L.–Class B Covering
Cast stone	A. C. I. 704
Cements, Keene's	F. S.–SS–C–161
	A. S. T. M.–C–61
portland	F. S.–SS–C–191a
	F. S.–SS–C–201a
	A. S. T. M.–C–9
prepared masonry (for mortar)	F. S.–SS–C–181b
	A. S. T. M.–C–91

Material	*Specification Number or Volume Including Specification*
Concrete block, hollow	F. S.–SS–C–621
Load-bearing	A. S. T. M.–C–90
non-load-bearing	F. S.–SS–C–621
	A. S. T. M.–C–129
solid, load-bearing	A. S. T. M.–C–145
Concrete, reinforced	A. C. I. Building Code
Copper, sheet	F. S.–QQ–C–501a
Electric	
Regulations for Electric Wiring & Apparatus	N. B. F. U.–70
List of Inspected Electrical Equipment	U. L.
Fiber board, insulating	F. S.–LLL–F–321b
structural	F. S.–LLL–F–311
Fire-clay, plastic	F. S.–HH–R–191
	A. S. T. M.–C–105
Flooring, oak	C. S.–56
Galvanized sheet metal, see Sheet metal.	
Glass, flat for glazing purposes	F. S.–DD–G–451
Hardware, builders	C. S.–22
Heating, see mechanical equipment references.	
Lath, gypsum board	A. S. T. M.–C–37
metal	F. S.–QQ–B–101c
Lead, sheet	F. S.–QQ–L–201
Lime, quick	F. S.–SS–Q–351
	A. S. T. M.–C–5
hydrated	F. S.–SS–L–351
	A. S. T. M.–C–6
Linoleum, plain, jaspe and marbleized	F. S.–LLL–L–367
inlaid and molded	F. S.–LLL–L–359
Lumber	S. P. R.–R–16
Metal roofing, see Copper, lead, tin, zinc.	
Mortar, see Cement, prepared masonry (for mortar). See Aggregates, masonry mortar.	
Paper, sheathing, waterproof	F. S.–UU–P–536
Pipe	
cast-iron	F. S.–WW–P–401
	A. S. T. M.–A–142
clay sewer	F. S.–SS–P–361a
	A. S. T. M.–C–13
	A. S. T. M.–C–200
wrought iron	F. S.–WW–P–441a
	A. S. T. M.–A–72
brass	F. S.–WW–P–351
	A. S. T. M.–B–43
copper	F. S.–WW–P–377
	A. S. T. M.–B–42

Material	*Specification Number or Volume Including Specification*
Plaster, gypsum	F. S.–SS–P–401 A. S. T. M.–C–28 A. S. T. M.–C–36
Plaster, board, gypsum	F. S.–SS–P–431a
Plywood (Douglas Fir)	C. S.–45
(Western Hemlock)	C. S.–122
Plumbing	
fixtures	F. S.–WW–P–541a
Formed Metal Fixtures	F. S. WW–P–542
Plumbing Manual	B. M. S.–66
Sanitary Cast Iron Enameled Ware	C. S.–77
Prepared masonry cement, see Cement.	
Roofing felt, asphalt-saturated	F. S.–HH–F–191a A. S. T. M.–D–226
Sheathing board, gypsum	F. S.–SS–S–276 A. S. T. M.–C–79
Sheet metal, galvanized	F. S.–QQ–I–716 A. S. T. M.–A–93
Shingles, asbestos cement	F. S.–SS–S–291a
asphalt, mineral surfaced	F. S.–SS–R–521 A. S. T. M.–D–225
slate	F. S.–SS–S–451
wood	C. S.–31
Siding, cement-asbestos	F. S.–SS–S–346
Slag	F. S.–SS–A–281a A. S. T. M.–C–33
Stairs, Hardwood Treads and Risers	C. S.–89
Steel, design, fabrication and erection	A. I. S. C. Code of Standard Practice
reinforcing	A. S. T. M.–A–15 and A–16
structural	F. S.–QQ–S–741 A. S. T. M.–A–7
Tile, clay for floor and walls (ceramic)	S. P. R.–R–61
drain	F. S.–SS–T–310 A. S. T. M.–C–4
floor, asphalt	F. S.–SS–T–306a
floor, rubber	F.S.–ZZ–T–301
load-bearing clay	F. S.–SS–T–341a A. S. T. M.–C–34
non-load-bearing clay	F. S.–SS–T–351a A. S. T. M.–C–56
Tin, roofing (terne-plate)	F. S.–QQ–T–201
Wallboard, composition	F. S.–UU–W–101a
gypsum	F. S.–SS–W–51a A. S. T. M.–C–36

Void

Material	*Specification Number or Volume Including Specification*
Plaster, gypsum	F. S.–SS–P–401 A. S. T. M.–C–28 A. S. T. M.–C–36
Plaster, board, gypsum	F. S.–SS–P–431a
Plywood (Douglas Fir)	C. S.–45
(Western Hemlock)	C. S.–122
Plumbing fixtures	F. S.–WW–P–541a
Plumbing Manual	B. M. S.–66
Sanitary Cast Iron Enameled Ware	C. S.–77
Prepared masonry cement, see Cement.	
Roofing felt, asphalt-saturated	F. S.–HH–F–191a A. S. T. M.–D–226
Sheathing board, gypsum	F. S.–SS–S–276 A. S. T. M.–C–79
Sheet metal, galvanized	F. S.–QQ–I–716 A. S. T. M.–A–93
Shingles, asbestos cement	F. S.–SS–S–291a
asphalt, mineral surfaced	F. S.–SS–R–521 A. S. T. M.–D–225
slate	F. S.–SS–S–451
wood	C. S.–31
Siding, cement-asbestos	F. S.–SS–S–346
Slag	F. S.–SS–A–281a A. S. T. M.–C–33
Stairs, Hardwood Treads and Risers	C. S.–89
Steel, design, fabrication and erection	A. I. S. C. Code of Standard Practice
reinforcing	A. S. T. M.–A–15 and A–16
structural	F. S.–QQ–S–741 A. S. T. M.–A–7
Tile, clay for floor and walls (ceramic)	S. P. R.–R–61
drain	F. S.–SS–T–310 A. S. T. M.–C–4
floor, asphalt	F. S.–SS–T–306a
floor, rubber	F.S.–ZZ–T–301
load-bearing clay	F. S.–SS–T–341a A. S. T. M.–C–34
non-load-bearing clay	F. S.–SS–T–351a A. S. T. M.–C–56
Tin, roofing (terne-plate)	F. S.–QQ–T–201
Wallboard, composition	F. S.–UU–W–101a
gypsum	F. S.–SS–W–51a A. S. T. M.–C–36

Material	*Specification Number or Volume Including Specification*
Wood preservatives	A. W. P. A.
Wood siding, see Lumber.	
Wire fabric, galvanized	F. S.–QQ–B–101c
Zinc	F. S.–QQ–Z–301a A. S. T. M.–B–69

Mechanical Equipment References	*Source & Number or Volume*
Heating, Ventilating & Air-Conditioning Engineers' Guide	A. S. H. & V. E.
Measurements of Heat Losses From Slab Floors	B. M. S.–103
Building Code Recommended by the National Board of Fire Underwriters	N. B. F. U.
Regulation for the Installation of Air-Conditioning, Warm Air Heating, Air Cooling & Ventilating Systems, Part II	N. B. F. U.–90
Regulations for the Installation of Oil Burning Equipment	N. B. F. U.–31
Regulations for the Installation, Maintenance & Use of Small Heating & Cooking Appliances (Kerosene & Fuel Oil)	N. B. F. U.–310
List of Inspected Gas, Oil & Miscellaneous Appliances	U. L.
Directory of Approved Gas Appliances & Listed Accessories	A. G. A.
Requirements for House Piping & Appliance Installation	A. G. A.
Approval Requirements for Gas Water Heaters	A. G. A.
Approval Requirements for Central Heating Gas Appliances	A. G. A.
Listing Requirements for Attachable Gas Water Heating Units	A. G. A.
Approval Requirements for Gas Space Heaters	A. G. A.
Approval Requirements for Domestic Gas Ranges	A. G. A.
Listing Requirements for Gas Conversion Burners	A. G. A.
Approval Requirements for Hot Plates & Laundry Stoves	A. G. A.
Approval Requirements for Gas Unit Heaters	A. G. A.
Approval Requirements for Refrigerators Using Gas Fuel	A. G. A.
The Gravity Code and Manual for the Design & Installation of Gravity Warm Air Heating Systems	N. W. A. H. & A. C. A.
The Code and Manual for the Design and Installation of Warm Air Winter Air Conditioning Systems	N. W. A. H. & A. C. A.
A Yardstick for the Evaluation of a Forced Warm Air Heating System	N. W. A. H. & A. C. A.

Mechanical Equipment References	*Source & Number or Volume*
I–B–R Testing & Rating Code	I. B. R. M.
I–B–R Ratings for Cast Iron Boilers	I. B. R. M.
I–B–R Installation Guide—One Pipe Forced Circulation Hot Water Heating Systems—#1	I. B. R. M.
I-B-R Installation Guide No. 2 - One Pipe Steam Heating System	I.B.R.M.
Steel Boiler Institute, Rating Code	S. B. I.
A. S. M. E. Code for Low Pressure Heating Boilers	A. S. M. E.
Specifications for Non-Ferrous Range Boilers & Hot Water Storage Tanks Used for Heating Water or Storing Water Under Street Pressure	N. F. H. W. T. M. A.
Automatic Mechanical Draft Oil Burners Designed for Domestic Installations	C. S. 75
Domestic Burners for Pennsylvania Anthracite (Underfeed Type)	C. S. 48
Fuel Oils	C. S. 12
Flue-Connected Oil-Burning Space Heaters Equipped With Vaporizing Pot-Type Burners	C. S.–101
Gas Floor Furnaces—Gravity Circulating Type	C. S.–99
Oil Burning Floor Furnaces Equipped With Vaporizing Pot-Type Burners	C. S.–113
Solid Fuel Burning Forced Air Furnaces	C. E.–109
Warm-Air Furnaces Equipped With Vaporizing Pot-Type Burners	C. S.–104
Tentative Standard for Coal Burning Space Heaters	T. S.–3443
Recommended Commercial Standard for Testing and Rating Hand-Fired Hot Water Supply Boilers	T. S.–3560a
Large Tube Cast Iron Radiators	S. P. R.–174
Steel Horizontal Firebox Heating Boilers	S. P. R.–157
Net Load Recommendations for Heating Boilers	H. P. & A. C. C. N. A.

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Void

Mechanical Equipment References	*Source & Number or Volume*
I–B–R Testing & Rating Code	I. B. R. M.
I–B–R Ratings for Cast Iron Boilers	I. B. R. M.
I–B–R Installation Guide—One Pipe Forced Circulation Hot Water Heating Systems—#1	I. B. R. M.
Steel Boiler Institute, Rating Code	S. B. I.
A. S. M. E. Code for Low Pressure Heating Boilers	A. S. M. E.
Specifications for Non-Ferrous Range Boilers & Hot Water Storage Tanks Used for Heating Water or Storing Water Under Street Pressure	N. F. H. W. T. M. A.
Automatic Mechanical Draft Oil Burners Designed for Domestic Installations	C. S. 75
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Oil Burning Floor Furnaces Equipped With Vaporizing Pot-Type Burners	C. S.–113
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Warm-Air Furnaces Equipped With Vaporizing Pot-Type Burners	C. S.–104
Tentative Standard for Coal Burning Space Heaters	T. S.–3443
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Large Tube Cast Iron Radiators	S. P. R.–174
Steel Horizontal Firebox Heating Boilers	S. P. R.–157
Net Load Recommendations for Heating Boilers	H. P. & A. C. C. N. A.

APPENDIX D

DRAWING AND SPECIFICATION REQUIREMENTS

A. General. Drawings and specifications shall be accurate and sufficiently complete to set forth and describe the intended physical improvements, and the size, grade, and quality of materials and workmanship to be incorporated in the improvements.

B. Drawings. Drawings shall be submitted in duplicate, and shall include the following:

1. Plot Plan

2. Floor Plans

3. Exterior Elevations

4. Details

5. Sections

6. Heating, plumbing, and wiring layouts.

C. Specifications.

1. Submit FHA Form No. 2005, Description of Materials, in duplicate, completed in accordance with instructions contained therein.

2. If work cannot be described adequately on FHA Form No. 2005, supplemental specifications shall also be submitted in duplicate.

3. When items of accessory equipment such as cooking range, gas or mechanical refrigerator, water softener, etc., are to be included as part of the mortgaged property, each item shall be described adequately by name, manufacturer, model number, type of finish, and size or capacity.

Note: The term "specifications" were used in this booklet refers to FHA Form No. 2005, Description of Materials, and any required supplemental specifications. FHA Form No. 2005 may be obtained without charge from any approved mortgagee, or from the FHA field office.

D. Requirements for Individual Water-Supply and Sewage-Disposal Systems. With each application involving a proposed installation of an individual water-supply or sewage-disposal system, or both, not less than the following exhibits shall be submitted in triplicate.

1. FHA Form No. 2217–13, for water-supply system, approved by the Illinois Department of Public Health.

2. FHA Form No. 2218–13, for sewage-disposal system, approved by the Illinois Department of Public Health.

3. Drawings and specifications as called for by FHA publication entitled "Requirements for Individual Water-Supply and Sewage-Disposal Systems"

E. Detailed Check List of Information Desired. Drawings and specifications shall be accurate and sufficiently complete to set forth and describe the intended physical improvements and the sizes, grade and quality of material and workmanship to be incorporated in the improvements. In general, the following information will be necessary for each item listed under B. Any variations will be subject to acceptance of the Chief Underwriter.

1. Plot Plan

a. Street address and description of property location, adequate to direct the inspector.

b. Location and overall dimensions of all existing or proposed structures, steps, terraces, and retaining walls.

c. Distances from building lines to all lot lines.

d. Easements and zoning or restriction requirements, if any.

e. Proposed elevation of first floor and related elevations of:

(1) Finished grade at all corners of building and at all corners of lot. If the gradient between the building and the lot boundaries is not uniform, show additional finished grade elevations at intervals of not more than 10′–0″.

(2) Finished grade of adjoining improved lots, if any.

(3) Established grade of adjoining thoroughfares at the extensions of the lot lines.

(4) Walks, steps, terraces, porches, driveways, and garage.

(5) Public sidewalk and curb.

(6) Public sewer and stub, if any.

(7) Average existing grade if plot slopes less than 2 feet in 100 feet. Show contour lines with an interval of elevation of 2 feet if plot slopes 2 feet or more in 100 feet.

f. North point.

g. Dimensions of plot and angles at intersections of boundary lines of plot, if such angles are more than 5° greater or smaller than 90°.

h. Size and location of public sewer serving subject property.

i. Established building lines.

j. Existing buildings or obstructions within 5 feet of boundary lines of lot.

k. Show all trees which are to remain on plot, and if specifications include landscaping indicate location, species, quantity, and size of all plants, shrubs, and trees to be planted.

2. Floor Plans (Including basement or foundation wall plans, and future finished attic of one and one-half (1½) story houses). All floor plans shall be drawn at a scale of not less than ¼″ equals 1′–0″, and shall include:

Direction, size, and spacing of all framing members; lintels for exterior masonry openings; materials of walls and partitions by crosshatching or other indication; height, width, and swing of doors; equipment, such as kitchen cabinets, bookcases, etc., drawn to scale. If reinforced concrete is used, show all details of construction, including size, bending, and spacing of reinforcing bars. Show complete overall and intermediate dimensions sufficient to locate all walls, partitions, stairs, floor openings, windows, doors, chimneys, etc.

3. Exterior Elevations. Show at not less than ¼″ equals 1′–0″: front, rear, sides, and offsets, indicating location, height, and width of all openings; finish floor and ceiling heights, and other necessary vertical dimensions; wall finish materials;gutters and downspouts; flashing; depth of footings; finish grades at building (same to agree with grades shown on plot plan and profile section).

4. Details, Interior and Exterior. Indicate design and construction, including any special items such as cabinet work, millwork, and entrance, drawn at a scale sufficiently large to indicate all essential information. A minimum scale of ½″ equals 1′–0″, is recommended. Standard methods of construction or stock details, if fully described in the specifications, need not be shown on drawings.

5. Sections.

1. Through Building. (Scale not less than ½″ equals 1′–0″.)

a. Typical wall section through typical windows, showing all construction above and below grade, including roof and footing construction. Show all dimensions and related elevations of floor levels and finished grade at building.

b. Section through wall where materials and/or framing vary from those shown in typical section.

c. Section through eaves where windows do not occur.

d. Section through special windows.

e. Section through bays, and other projections showing construction at junction of roof and ceiling with main wall.

f. Section through stairs.

2. Through lot. Show profile of lot, indicating related elevations of finished exterior grades and finished first floor, basement floor, entrance platform, slope of front yard, and walk to public sidewalks.

6. Heating, Plumbing, and Wiring Layouts. Show on separate drawings, or on applicable floor plan:

1. Heating.

a. Size and layout of heating units, pipes, ducts, registers, radiators, breechings, and any special arrangements.

b. Total maximum heat loss of dwelling, and of each room, in Btu per hour.

c. Location of thermostat in automatic systems.

d. Design data, such as water temperature, air temperature at bonnet and registers, capacity of fan or pump, air velocities, and outside temperature.

2. Plumbing.
   a. Fixtures.
   b. Soil stacks and vents.
   c. Horizontal runs of fixture drains.
   d. House sewer.
   e. Storm water drains.
   f. Domestic hot water equipment.
   g. Catch basin or grease trap, if provided.
   h. Sump pump, if provided.

3. Wiring (Use appropriate symbols).
   a. Light, power, and convenience outlets.
   b. Switches, showing type and connections to outlets.
   c. Location of meter and master switch.

F. Individual Water-Supply and Sewage-Disposal Systems. See FHA publication entitled "Requirements for Individual Water-Supply and Sewage-Disposal Systems", for necessary drawings.

APPENDIX E

DETAILED HEATING REQUIREMENTS

The material under this heading is a part of Heating Requirements, 500 through 503, compliance with which shall determine acceptability of heating equipment, and design and installation of heating systems. Any other method proposed, which, in the opinion of the Chief Underwriter, will result in installations which meet or exceed the performance requirements may be used.

SAFETY PROVISIONS

I–A. Protection From Fire Hazard. Provide protection from fire hazards by heater foundations, clearances and venting in accordance with the standards published by the National Board of Fire Underwriters.

I–B. Heater Foundations.

1. Heating units of conventional design for house heating or domestic water heating shall be mounted on:

a. Floors of fire proof construction.

b. Fire resistive construction with noncombustible flooring and finish.

c. Fireproof slabs or arches having no combustible material or insulating material against the underside, or

d. On a hollow masonry base at least 4 inches thick laid with ends open to permit free air circulation through the base.

2. The following types of heating units may be mounted on floors other than as described above provided the floor under the unit is protected with not less than ¼-inch asbestos covered with not less than #24 U. S. gauge sheet metal:

a. Forced warm air furnace units in which the fan chamber or intake plenum is constructed integrally with the unit and occupies the entire area beneath the firing chamber and forms a well ventilated air space, between the furnace (including ashpit of solid fuel burning units) and the floor, of 18 inches or more in height.

b. Boilers for central heating and domestic water heating, of the wet-base type in which the entire ashpit and firebox are water-legged.

c. Space heaters and domestic water heaters supported on legs which provide clear space under the appliance of not less than 6 inches.

3. The floor protection (asbestos & sheet metal) provided in B–2 above shall extend 6 inches beyond the appliance on all sides when gas or oil is used and 18 inches beyond the side or front of a solid fuel burning appliance where ashes are removed.

I–C. Clearances. Locate heating equipment so that the clear space between any heated surface and combustible construction is sufficient to prevent temperatures of more than 160° F. on such constructions. Unless specifically provided otherwise, the clearances generally shall be as follows:

I–C. Clearances. *Continued.*

Temp. of Surface Radiating Heat	*Example Surface*	*Clearances (inches)* *Top*	*One Side and Rear*	*Other Side and Front*
200 to 400	Warm Air Furnace Jackets, Space Heaters, (Circ. type)	12	12	18
400 to 600	Cleanout doors, Fire doors	18	18	18
600 to 1,000	Radiant Space Heaters, smoke pipe	36	36	48

When the combustible construction or the surface radiating heat is protected the clearances may be reduced in amount proportioned to the effectiveness of the protection provided.

In systems where the air is heated by a coal fired furnace, all portions of the supply ducts and supply plenums exposed to direct heat rays from the furnace heating surface shall clear combustible construction, including incombustible surface material mounted against combustible construction, by at least 8 inches.

HEAT LOSS CALCULATION

II–A. The maximum hourly heat loss for each heated space shall be calculated in accordance with the procedure described in the the current edition of the "Guide" of the American Society of Heating and Ventilating Engineers or by any recognized method which is suitable to local conditions provided the results obtained are in substantial agreement with, and not less than those obtained by using the procedure described in the "Guide" of the ASHVE. Regardless of the method used, and for the purpose of simplifying the calculations, the following basic data shall be used:

1. The outside design temperature used in the calculation shall be that established by FHA for the locality in which the dwelling is located.
2. The inside design temperature used in the calculations shall be not less than 70° F. except that a lower inside design temperature acceptable to the Chief Underwriter may be used in calculating the heat loss from playrooms, laundry rooms, enclosed service porches, heated garages, and similar spaces.
3. The calculation of heat loss from heated spaces into adjacent spaces such as attics, basementless areas and heated or unheated garages shall be based on the assumption that the temperature of such adjacent spaces is the same as the outside design temperature.
4. All conventionally constructed floors over basements or other warmed spaces are assumed to have no heat loss into those spaces.
5. Transmission coefficients used in the calculation shall be those listed in the "Guide" or Federal Housing Administration Circular "Calculation of Building Section, Heat Transmission Coefficients", or as established by tests acceptable to the Chief Underwriter.

6. Infiltration heat loss shall be calculated as the heat required to raise the temperature of an amount of air equal to the cubical contents of all the heated space in the dwelling from the outside design temperature to the inside design temperature in one hour (one air-change per hour).
7. Heat losses through concrete floor slabs on the ground shall be calculated in accordance with the perimeter method described in BMS Report No. 103 by the National Bureau of Standards. See II–B.
8. The reduction in heat loss effected by storm windows and doors specified and furnished shall be credited in the heat loss calculation.

II–B. Heat Loss Through Slab Floors on the Ground. The slab type of concrete floor laid on the ground presents an individual problem. Recent tests at the National Bureau of Standards indicate that slab floors laid on the ground lose heat principally from areas near the exposed edge. Although some heat is lost from other portions of the slab, the rate of loss decreases rapidly as the distance from the exposed edge increases. The conclusions drawn from the tests are that:
1. The heat loss through the floor is proportional to the exposed perimeter of the floor and to the total degree days occurring in the locality during the month preceding the date for which the calculation is made.
2. The use of stone, gravel, or cinders in a depth of several inches and a layer of tar paper or other material impervious to water, placed under the floor

a. prevents the penetration of water

b. insulates the floor sufficiently to permit the temperature of the floor to follow the temperature of the air above it and thus lessen the probability of condensation on the floor surface in summer.

3. The temperature variation on the floor surface is significant for only a short distance (4′ or less) from the edge.
4. The use of an insulating strip at the edge or between the edge of the floor slab and the foundation wall materially lowers the edge heat loss, raises the floor surface temperature in the area near the edge and thereby improves the comfort conditions and lessens the probability of condensation on this portion of the floor surface in winter.

The foregoing tests and the conclusions derived therefrom indicate that the heat loss from slab floors on the ground can be determined easily and more accurately than by previously used methods, by a method employing the Perimeter Formula. This formula which follows shall be used for calculating the heat loss from slab floors on the ground.

$$H_f = F_1 \times P \times D_j,$$

in which

H_f = Total heat loss from slab floor (Btu per hour).
F_1 = Heat loss factor obtained from Building Materials and Structures Report, BMS 103 of the National Bureau of Standards. Typical factors range from 0.020 to 0.040.
P = Perimeter of floor is feet.
D_j = Average January degree days over a period of at least five years, as issued by the United States Weather Bureau.

ACCEPTABILITY OF HEATING SYSTEMS ACCORDING TO THE HEATING MEDIUM AND METHOD OF DISTRIBUTION

III–A. When the heating medium is hot water or steam circulated through a system of pipes connected to radiators, convectors or other heat exchanging devices:

1. Circulation may be by gravity when the top of the boiler is below the floor level of all first floor habitable spaces provided the system is designed in accordance with the requirements for gravity circulation hot water or steam systems, whichever is applicable.

2. Mechanical circulation shall be provided when the top of the boiler is above the first floor level, or when the boiler is below the first floor level and the system is not designed to operate by gravity circulation. The system shall be designed in accordance with the requirements for a forced circulation hot water system or mechanical condensate return system, whichever is applicable.

III–B. When the heating medium is warm air supplied to or returned from the spaces to be heated through a system of ducts:

1. Circulation may be by gravity when the top of the furnace is below the floor level of all first floor habitable spaces and the tops of all supply registers are within 18 inches of the floor provided the system is designed in accordance with the requirements for a gravity circulation warm air system.

2. Mechanical circulation shall be provided if the duct resistance due to limited size, length and turns will prevent adequate gravity circulation, if the top of any supply register is more than 18 inches from the floor, or if the top of any supply register is below the top of the furnace. The system shall be designed in accordance with the requirements for a forced circulation warm air system unless the system comes under the provisions of III–C.

III–C. If heated air is supplied by means of a device such as a space heater, floor furnace, wall heater, pipelines furnace or similar device the following requirements shall apply:

1. The distance center to center between a supply outlet and any space to be heated by it, measured through the center of intervening openings, shall not exceed 18 feet.

2. If the supply outlet and return inlet of the device are in the same space, there shall be no more than one doorway and one archway between the supply outlet and any space to be heated by it.

3. If the only supply outlet and the only return inlet of the device are not in the same space there shall be no more than one doorway and one archway between the supply outlet and any space to be heated by it and no more than one doorway and one archway between the supply outlet and the return inlet of the device. If there is a doorway between the supply outlet and the return inlet it shall have a fixed louvered opening with a net free area not less than 8 square inches per 1,000 Btu gross output rating of the device.

4. If the principal supply outlet and the principal return inlet are not in the same space and if ductwork has been added to the device, there shall be no more than one doorway and one archway between a supply outlet and any room to be heated by it except where the kitchen is in the path of return air to the principal return inlet. Each door in path of air flow, between the principal supply outlet and the principal return inlet shall be provided with fixed louvered openings with the opening in each door having a net free area of not less than 8 square inches per 1,000 Btu of gross output rating of the device.

5. The maximum hourly heat loss from the dwelling or that portion of the dwelling which one unit is intended to heat shall not exceed 45,000 Btu. This may be increased to 50,000 Btu if an air circulating fan is incorporated in the unit.

6. If a fan is provided it shall have a quiet performance capacity as installed of not less than 10 cfm per 1,000 Btu gross rated capacity of the device. A fan of insufficient capacity is indicated by an air temperature rise through a heater of more than 100° F when the heater is fired at its maximum rating. Fan shall be so controlled that it will operate at all times when the air temperature at the device outlet is above 135° F. No means shall be provided for manually breaking the fan electrical circuit. Except for quietness, this paragraph does not apply to free standing fan-equipped space heaters not installed in connection with ductwork.

7. If ductwork is added to the device but of insufficient extent for the system to be considered a conventional gravity or forced circulation system, the following additional requirements shall apply:

a. Ductwork installations shall comply with the provisions of National Board of Fire Underwriters Pamphlet No. 90.

b. Ductwork shall be connected to the device.

c. A fan complying with 6 above shall be provided if top of device is above floor level of any space to be heated by it, or if top of any outlet register is more than 18 inches above the floor.

d. A total net free area of not less than 8 square inches per 1,000 Btu of gross output rating of the device shall be maintained throughout the supply system and also throughout the return system.

e. If more than one supply outlet is provided the net free area of the outlets and branch ducts shall be proportioned approximately in accordance with the heat losses of the portions of the dwelling they are intended to heat. Unless the bathroom is otherwise heated in a manner acceptable to the Chief Underwriter, a supply outlet shall be provided in the bathroom.

f. If device is coal fired or if manual control is used for other fuels, at least ½ of the branch supply duct area shall run untrapped from top of heater to unvalved outlet or outlets. Balancing dampers, if provided, shall not close more than 50% of the area of any duct.

III–D. No return air inlet shall be located in a bathroom, a room or space likely to be used for fuel or other storage, a confined space in which the combustion air intake is located such as the air intake of a gas- or oil-fired unit or the ash pit door of a coal-fired unit, or a confined space in which a draft diverter or draft regulator is located. A basement space shall not be used as a return plenum. A crawl space below first floor may be used as a return plenum provided the enclosing materials are not subject to decay or corrosion in the presence of moisture, the space is made tight against excessive air leakage and the ground is surfaced with at least 2 inches of concrete or other suitable material and the space is not designed to serve for storage.

CAPACITY OF HEATING EQUIPMENT

IV–A. The net outputs in Btu per hour of radiators, convectors, registers, heat exchangers and heating surfaces shall be not less than the heat loss of the spaces which they heat and shall be proportioned so as to provide an acceptable uniformity of temperature throughout the dwelling.

For air heating devices net output shall be not less than the calculated heat loss of the spaces which it is intended to heat. For boilers net output shall be not less than the calculated heat loss of the spaces plus the prescribed allowance for attached domestic water heaters, if any. The manufacturer's published net output shall be used when it is less than the net output as defined below.

IV–B. The following definitions of ratings are applicable when the heating device or equipment is operated within the limits of the applicable code or rating procedure:

1. Input rating is the rated fuel consuming capacity of a heating device.

2. Gross output is the heat delivered in Btu per hour:

a. In the air at the bonnet of a furnace or at the register of a floor, wall, or pipeless gravity furnace.

b. In the steam or water at the nozzle of a boiler.

c. At the discharge of an overflow heater.

3. Net output is the gross output less allowance for ordinary piping losses and pickup.

PIPED DISTRIBUTION SYSTEMS

Systems consisting of boilers in which water is heated and pipes conducting hot water or steam to radiators or convectors shall comply with the following:

V–A. Boilers.

1. *Construction.* The construction of all hot water or steam heating boilers in which water is heated directly by the fuel and in which water is or may be subjected to pressures in excess of 5 lbs. per sq. in. and due solely to hydrostatic head of water shall be required to comply with the American Society of Mechanical Engineers' Code for Low Pressure Heating Boilers and each such boiler shall bear the symbol indicating compliance with A. S. M. E. Standards.

2. *Boiler Capacity.* Net boiler capacity shall be not less than the sum of all calculated loads and shall be as follows:

a. Hand fired or mechanically fired. The current Net Load Recommendation for Heating Boilers of the Heating, Piping and Air Conditioning Contractors National Association except that, where manufacturer's published or nameplate rating is less, the lower rating shall be used, or

b. Net load determined from certified test data submitted by the manufacturer to the Chief Underwriter and ruled by him as acceptable. Certified test data are to be substantially that required in the "I–B–R Testing and Rating Code" for cast iron boilers and the "S. B. I. Rating Code" for steel boilers.

c. Gas-fired boilers—50% of the American Gas Association input rating.

NOTE: *For boilers supplying domestic hot water to living units add 6,000 Btu for each living unit in excess of one.*

d. Boilers and boiler room equipment shall be so piped and valved as to be readily serviced and repaired. Electrical equipment shall not be installed beneath or adjacent to cleanouts of chimney or breeching.

e. All pumps shall be isolated by suitable connections to prevent transmission of vibration or noise.

3. *Trimmings and Firetools.*

a. Necessary firetools and cleaning brushes for properly maintaining the boiler shall be furnished.

b. Steam boilers shall be provided with safety valve, gauge glass and trycocks. Automatically fired steam boilers shall be provided with a low water cut-off supplied with the boiler by the boiler manufacturer.

c. Hot water heating boilers shall be equipped with an altitude or pressure gauge, thermometer, and, when connected to closed systems, shall be provided with a relief valve.

d. Boilers shall be connected to the house cold water supply with a shut-off valve and shall be provided with a drain cock suitable for connection with a hose for draining, or shall be piped to a drain.

4. *Insulation.* Boiler insulation shall be securely applied and shall be of thickness and insulating value adequate to prevent the overheating of living space. In no case shall the conductance of the insulating material plus any protective casing which may be used be greater than 0.50 Btu.

V–B. Pipe and Fittings.

1. All pipe for steam and hot water systems shall be steel, copper, brass or wrought iron and the ends shall be reamed full size.

2. Fittings shall be standard design and weight and of a material acceptable to the Chief Underwriter.

3. *Installation.*

a. Screw pipe and fittings shall be joined together with pipe compound applied to the pipe and not to the fitting.

b. Threads shall be clean and free from burrs.

c. All union connections shall be made so that there is no strain on the pipe and unions shall be accessible after the building is completed.

d. There shall be a ¾ in. drain valve at each low point of the system.

e. Piping passing through masonry walls shall be provided with sheet metal sleeves.

f. All supply piping and fittings of steam systems and all piping of hot water systems shall be insulated with material having an overall conductance of not more than 0.67 Btu.

g. All main piping shall be supported by suitable hangers located at least every 10 feet.

V–C. Radiators and Convectors.

1. Each radiator or convector shall be separately valved.

2. In addition each radiator or convector shall be provided with means of balancing the distribution of heat in the system. Balancing device may be integral with control valve but it shall be designed for locking in position and when so set shall not be affected by the operation of the control valve.

3. Enclosed unit shall be sized to compensate for effect of enclosure.

4. Top of radiators or outlet grilles: Maximum height above floor, 32 inches.

5. *Convectors.* Install in completely enclosing cabinets. Convector cabinets not of same manufacture as heating element shall have similar clearances around heating element, equally effective cabinet heights, and equivalent free areas of inlet and outlets, as cabinets with which the element was rated.

6. Insulate walls behind radiator recesses and recessed convectors with material having an overall conductance of not more than 0.67 Btu.

V–D. Hot Water System Design.

1. Design and install according to the recommendations in the current edition of the American Society of Heating & Ventilating Engineers "Guide". One pipe Forced Circulation systems may be designed in accordance with the procedure described in steps 2 through 11 inclusive in "I–B–R Installation Guide #1".

2. The maximum temperature drop through each radiator shall be:
   a. 20° for forced circulation systems,
   b. 35° for gravity circulation systems.

3. Radiators and convectors shall be selected so that they deliver their required output at temperatures not in excess of
   a. 220° for fully automatically fired systems,
   b. 180° for manually fired systems.

V–D. Hot Water System Design. *Continued.*

4. Protect from excessive pressures and loss of water by:

a. An open expansion tank with a visible overflow, all inside the building, or

b. A closed tank equipped with a relief valve.

5. Install one-pipe mains dead level except when specifically directed otherwise by manufacturer of special one-pipe fittings used. Run supply mains in two-pipe systems with a pitch upward in the direction of water flow at least ¼″ in 10 feet and return mains downward in the direction of water flow at least ¼″ in 10 feet.

6. All branches to radiators shall pitch upward toward the radiator not less than ½″ in 10 feet.

7. Install piping so that there are no air pockets in the system.

8. Provide accessible air valves and balancing fitting (see V–C–2) on all radiators and convectors and coils.

9. Provide an air chamber of not less than 6 cubic inches for each convector.

V–E. Steam System Design.

1. The design of steam systems shall be in accordance with the recommendations of the current "Guide" of the American Society of Heating & Ventilating Engineers.

2. Steam piping for one-pipe systems shall be sized in accordance with the following table:

Pipe Sizes for One-Pipe, Gravity, Low-Pressure Steam Heating System

Capacity in Sq. Ft. of Equivalent Radiation

Pipe Size Inches	Supply Main Dripped, Steam & Condensate Flow in Same Direction	Supply Risers Up-Feed	Branches to Supply Risers & Rads. not Dripped*	Wet Return Main	Dry Return Main	Rad Valve Sizes
¾	----------	25	----------	----------	----------	---------
1	56	45	28	----------	----------	28
1¼	122	98	62	1,200	670	62
1½	190	152	93	1,900	1,060	93
2	386	288	169	4,000	2,300	169
2½	635	464	260	6,700	3,800	----------

*Note: *Radiator branches more than 8′ in length shall be one size larger than shown. Minimum return pipe size 1¼″.*

3. Run main vertically full size of boiler tapping and pitch horizontal run down in direction of steam flow at least ¼″ in 10 feet.

4. Take off undripped runouts at 45° from horizontal main and pitch upward in direction of steam flow at least 1 inch in 10 feet.

5. Provide automatic quick vent in the main, set vertically in a tee at least 2 feet beyond the last runout on one-pipe systems.

6. Provide an adjustable air vent valve in each radiator in one-pipe systems.

7. Provide swing joints at the foot of all second floor risers.

8. Provide for balancing in one-pipe systems by means of adjustable air vent valves; in two-pipe systems by means of orifices or orificed supply valves.

9. Connect return pipe to boiler through a Hartford connection.

10. Equip automatically fired systems with low water cut-off supplied with the boiler by the boiler manufacturer.

DUCT DISTRIBUTION SYSTEMS

VI–A. Furnace Capacity.

1. *Gravity Furnaces.* Net register output rating in Btu. per hour shall be:

a. For coal burning, hand fired:

(1) With secondary heating surface of at least five times grate area and

(a) With any ratio of total heating surface to grate area between 15 to 1 and 25 to 1 inclusive: not more than 1785 times the heating surface in sq. ft.

(b) With a ratio of total heating surface to grate area greater than 25 to 1: not more than 1785 x 25 x grate area in sq. ft.

(2) Without secondary heating surface or with secondary heating surface less than five times the grate area and with a ratio of total heating surface to grate area of at least 15 to 1: not more than that determined by multiplying the grate area in sq. in. by the factor opposite the applicable ratio in the following table:

Ratio	*Btu per sq. in. of Grate Area*	*Ratio*	*Btu per sq. in. of Grate Area*	*Ratio*	*Btu per sq. in. of Grate Area*
15–1	156	21–1	220	26–1	267
16–1	167	22–1	230	27–1	272
17–1	177	23–1	241	28–1	276
18–1	188	24–1	251	29–1	281
19–1	198	25–1	262	30–1	
20–1	209			and over	286

b. For oil fired gravity furnace-burner units (any type burner): not more than 75 percent of the bonnet capacity determined in accordance with "Warm Air Furnaces Equipped with Vaporizing Pot Type Burners," Commercial Standard CS104.

c. For gravity gas fired furnace units: not more than 75 percent of the AGA bonnet output rating.

d. For gravity furnaces with or without secondary surface, converted to automatic firing with stokers, oil burners, or conversion gas burners or for furnace-burner units for which adequate test data are not available: not more than the corresponding gravity coal-burning hand-fired rating.

2. *Forced Air Furnaces.* Net register output rating in Btu per hour shall be:

a. For coal burning hand fired

(1) With or without secondary heating surface and with any ratio of total heating surface to grate area: not more than 85 percent of the bonnet output rating determined in accordance with "Solid Fuel Burning Forced-Air Furnaces" Commercial Standard CS109 or, when such rating has not been determined,

(2) With secondary heating surface at least five times the grate area and

(a) With any ratio of total heating surface to grate area between 15 and 25 to 1 inclusive: not more than 2265 times the heating surface in sq. ft.

(b) With a ratio of total heating surface to grate area greater than 25 to 1: not more than 2265 x 25 x grate area in sq. ft.

(3) Without secondary heating surface or with secondary heating surface less than five times the grate area and with a ratio of total heating surface to grate area of at least 15 to 1: not more than that determined by multiplying the grate area in sq. in. by the factor opposite the applicable ratio in the following table:

Ratio	*Btu per sq. in. of Grate Area*	*Ratio*	*Btu per sq. in. of Grate Area*	*Ratio*	*Btu per sq. in. of Grate Area*
15–1	198	21–1	278	26–1	338
16–1	211	22–1	292	27–1	344
17–1	225	23–1	305	28–1	350
18–1	238	24–1	319	29–1	356
19–1	252	25–1	332	30–1	
20–1	265			and over	362

b. For oil fired forced circulation furnace-burner units (any type burner): not more than 85% of the bonnet capacity determined in accordance with "Warm Air Furnaces Equipped with Vaporizing Pot Type Burners", Commercial Standard CS104.

c. For forced circulation gas fired furnace units: 85% of the AGA bonnet output rating.

d. For forced circulation warm air furnaces converted to automatic firing with stokers, oil burners, or conversion gas burners or for furnace-burner

units for which adequate test data are not available: not more than the corresponding forced air coal-burning hand-fired rating.

e. Heating surface and grate area shall be measured according to the current edition of the Codes and Manuals of the National Warm Air Heating and Air Conditioning Association. Secondary heating surface is heating surface so constructed and located that direct light of the fuel bed or burner does not shine upon any part of it.

f. Forced air furnace blower shall have a capacity in cfm of not less than 1/75 of the maximum net output in Btu per hour of the furnace to which it is attached when the blower wheel is operating at a peripheral speed not greater than 1600 fm and when the pressure in the bonnet is not less than 0.20 inches of water. The blower shall be built and installed in a manner which will assure continued quiet operation.

VI–B. Furnace Construction.

1. All cast iron warm air furnaces for gravity or forced warm air systems, except gas fired furnace-burner units, shall be constructed so that the minimum thickness at any point is not less than ¼" and thickness at areas exposed to high temperature is not less than ⅜". Gas fired furnace-burner units shall comply with the Approval Requirements, American Gas Assoc.

2. All steel furnaces shall be constructed with a minimum thickness of No. 14 U. S. S. gauge for secondary heating surfaces and No. 10 U. S. S. gauge for primary heating surfaces except for oil fired furnace-burner units which may be constructed in accordance with the requirements in "Warm Air Furnaces Equipped with Vaporizing Pot-Type Burners" Commercial Standard CS–104 and for gas fired furnaces which shall comply with the Approval Requirements of the American Gas Association.

3. Heating surface on the suction side of the fan is acceptable only when:

a. Certified test data show that the temperature of the air measured at the inlet of the fan does not exceed 120° F. when the furnace is operating at its rated capacity.

b. In the absence of certified test data indicating compliance with (a) above, the actual measured area of such heating surface on the suction side of the fan shall not exceed 30% of the total heating surface.

c. Such surface is constructed of material not less durable than the minimum required by the applicable code or requirement for the construction of the primary heating surface of the combustion chamber section.

d. All joints between secondary and primary surfaces are welded or made with tight fitting bolted gasket external to that part of the furnace casing on the suction side of the fan.

e. The smokepipe extension, if any, is an integral part of the secondary surface and extends outside the casing and is constructed of material the same as the combustion chamber.

4. Casings shall be of incombustible material, tight fitting and securely fastened to the furnace so as to maintain proper clearances. A liner or insulation shall be applied to prevent the casing surface temperatures rising above 230° F. when operating at maximum rated capacity.

VI–B. Furnace Construction. *Continued.*

5. Filters shall not be exposed to direct radiant heat and shall be located so that the temperature of the filter is not raised by furnace heat more than 90° F. Filters shall not be installed in coal burning furnace installations.

VI–C. Furnace Installation—Forced or Gravity.

1. Locate gravity furnace so that lengths of supply ducts are as nearly equal as possible.
2. Joints between the bottom of the furnace and the foundation through which air may pass into the heating air stream shall be tightly sealed. The furnace parts shall be assembled plumb and level and joints requiring cement shall be well fitted.
3. Warm air furnaces which are fired by hand and equipped with a fan to circulate air shall be provided with an automatic damper regulator controlled by a room thermostat.
4. An air circulating fan connected to a warm air furnace shall be controlled by means of a temperature-actuated control located in the bonnet of the furnace or in the main supply duct near the furnace and shielded from radiated heat. This control shall cause the fan to operate at all times when the air in bonnet is above a predetermined temperature and shall be provided with a limit on the setting so that it cannot be set at a temperature higher than 200°. Any other method of automatic control designed to accomplish the same result shall be submitted as a special method for consideration of acceptability. There shall be no manual disconnect switch in the fan electrical circuit.
5. Warm air furnaces which are automatically fired or are equipped with an automatic damper regulator shall be equipped with a temperature-actuated limit control, located in the bonnet of the furnace or in a main supply duct near the furnace and shielded from radiated heat. This control shall shut off or reduce the fuel supply to the oil burner, gas burner, or stoker, or cause the damper regulator to check the fire in the case of a hand fired installation, whenever the air temperature exceeds a predetermined setting (not higher than 250°), until the temperature has returned to a lower predetermined setting.
6. The controls required in 4 and 5 above may be combined in a single combination control.

VI–D. Duct Work Construction and Installation—Gravity and Forced Systems.

1. *General.* Comply with current Standards of the National Board of Fire Underwriters, Pamphlet No. 90. A combination of gravity and forced circulation of air is not acceptable. Use of propeller fan will not alter the requirements for a gravity system nor permit a reduction in supply or return duct sizes.

2. *Supply and return ducts.*

a. All supply registers and return grilles shall be connected to the furnace or other heating unit by means of fittings or fittings and ducts which are closed, continuous and substantially air tight and throughout which the calculated required free area is maintained.

b. All fittings are to be of standard design without sharp turns and so fabricated and assembled that friction is minimized.

c. Slip joints shall provide at least 1 inch lap.

d. Calculated area of round duct shall be increased 10 percent to determine area of equivalent rectangular duct.

e. Calculated area of rectangular duct may be reduced 10 percent to determine area of equivalent round duct.

f. Duct fittings and connections shall be of sheet metal or other material accepable to the Chief Underwriter.

3. Insulate all supply or return ducts in exterior walls, attics and spaces under basementless houses with material having an overall conductance of not more than 0.67 Btu.

4. *Supply ducts and registers.*

a. Supply duct area shall be determined as in E or F following, depending on whether forced or gravity system is used. Free area of register shall be not less than the calculated area of the respective supply duct.

b. Provide register valves in all bedroom and kitchen supply registers.

c. A means other than a register valve such as a splitter, turn, or stack-head damper shall be provided to control the air distribution to each supply register. When a splitter or turn damper is used, it shall have an accessible operating handle which indicates the position of the blade.

d. All supply ducts in warm air systems shall be constructed entirely of metal or other noncombustible material equivalent in structural strength and durability to the following:

Round Ducts

Diameter, Inches	*Min. Wgt. of Tin*	*Min. Thickness of Galv. Iron*
10 and less	IC (107 lbs.)	28 U. S. Gauge
10 to 14	IX (135 lbs.)	26 U. S. Gauge
Larger than 14	----------	24 U. S. Gauge

Rectangular Ducts

Largest Dimension, Inches	*Min. Thickness of Galv. Iron*
Less than 14	28 U. S. Gauge
14 or more	26 U. S. Gauge

(Cross-break top and bottom panels of all ducts 24″ and wider.)

e. Any lining used in supply ducts shall be of fire-resistant material acceptable to the Chief Underwriter.

f. Joints and seams of all supply ducts shall be securely fastened and made substantially air tight; seams made with a drive cleat or Pittsburgh lock.

g. Supply ducts shall be securely supported by metal hangers, straps, or brackets. No nails shall be driven through the duct walls and no unnecessary holes shall be cut therein. When access or hand holes are cut they shall be provided with tightly fitted cover plates.

5. *Safety Provisions Relating to Ducts.*

a. Supply ducts which run in the open, such as those which run approximately horizontal and near the ceiling, shall have clearances as follows:

(1) From metal ducts to combustible material, including wood lath and plaster: not less than one inch;

(2) From metal ducts to metal lath and plaster or other incombustible finish attached to combustible material: not less than ¼ inch;

(3) For metal ducts covered with ½ inch or more of incombustible insulating material: no clearance required;

(4) From ducts made of asbestos-cement (or equivalent) to combustible material: one-half that specified for metal ducts.

b. Supply ducts which pass through combustible floor or ceiling shall:

(1) Clear such construction by at least $\frac{5}{16}''$, or

(2) Be of double wall construction with a continuous air space of not less than $\frac{5}{16}''$ between the inner and outer walls and any remaining space around the duct filled with incombustible material.

c. Supply ducts enclosed in combustible floor, wall or ceiling shall:

(1) Clear combustible construction by $\frac{5}{16}''$, or

(2) Be of double wall construction with a continuous air space of not less than $\frac{5}{16}''$ between the inner and outer walls, or

(3) Be insulated with incombustible material having a conductance of not more than 0.67 Btu.

d. Where supply ducts are located in closets and similar spaces, they shall be insulated with incombustible material having an overall conductance of not more than 0.67 Btu and shall be protected against mechanical damage.

e. Where installation of supply ducts in walls, floors or ceilings requires the removal of fire-stopping the spaces around the ducts where such fire-stopping was removed shall be tightly filled with incombustible insulating material having an overall conductance of not more than 0.67 Btu.

f. Where registers are installed in the floors or walls of combustible construction, the register box shall clear the construction by not less than $\frac{5}{16}''$.

g. Pipeless furnace-registers shall be installed in a register box constructed with an air space of not less than 4 inches between it and combustible construction except when the warm air passage is surrounded by a cold air passage.

h. Warm air systems using coal as fuel shall be protected against hazards due to overheating by the following:

(1) Omit filters.

(2) Omit register valves from registers supplying living room and bath.

(3) Arrange each balancing damper so that it cannot reduce by more than 50% the air flow through the duct in which it is installed.

6. *Return ducts and grilles.*

a. One or more return grilles for each living unit shall be installed in the floor or at floor level and shall be so located that it is not necessary for return air from one habitable room to traverse another habitable room to enter the return opening nor for air admitted through a main outside entrance door or being returned from upstairs spaces to pass across the principally used portion of the living room floor to enter the return.

b. Free area of return: not less than calculated leader pipe or trunk area. See D–2 above.

c. Returns from bathrooms or garages are not acceptable.

d. Provide register valve for each return opening located in bedroom or kitchen.

e. Return ducts or grilles serving one living unit shall not be connected with those serving any other living unit nor shall air returned from one living unit be re-circulated to any other living unit. Public halls shall not be used as a return plenum chamber.

f. Joist spaces, other than those adjacent to the outside walls, may serve as return ducts for gravity systems only. The upper portion of such spaces shall be made tight with sheet metal or heavy asbestos paper tightly secured to the subfloor and the framing members. The sides of the framing members need not be covered except as required in 6–g below. Joist spaces may be closed for this purpose with metal, dense composition board, cement-asbestos board, or other similar rigid material acceptable to the Chief Underwriter.

g. Incombustible material shall be used in the construction of return ducts, and for complete lining of joist spaces used as return ducts in the following locations:

(1) Within 2 feet, by shortest measurement, of casing, supply plenum, smoke pipe or vent, of any heater.

(2) For a vertical return duct located at the heater, and, in addition, the portion of a horizontal duct or joist space for a distance of 2 feet from the near edge of the connection of this horizontal duct or joist space with the vertical duct.

(3) Where a fire hazard may exist in ducts due to particles dropped through a register or heater, such as directly under floor registers or return grilles, at the bottom of vertical ducts, or directly under heaters having a bottom return.

VI–E. Design of Gravity Circulation Warm Air Systems. *See also VI–D.*

1. *General.*

a. Design and install according to the current edition of the "Gravity Code and Manual" of the National Warm Air Heating and Air Conditioning Association except where specifically provided otherwise in this appendix.

b. For Heat Loss Calculation see II–A.

2. Run separate duct from furnace to each supply register.

3. Area of leaders and stacks shall be determined in accordance with a or b following:

a. The "Gravity Code and Manual" of the National Warm Air Heating and Air Conditioning Association.

b. The following formulae and limitations:

(1) First story baseboard or floor registers:

$$\text{Round leader pipe area in sq. in.} = \frac{\text{Btu hourly heat loss}}{130-4E-1.5L}$$

(2) For second story baseboard registers:

$$\text{Rectangular wall stack area in sq. in.} = \frac{\text{Btu hourly heat loss}}{283-13E-3L}$$

Round leader pipe area = 150 percent of calculated wall stack area.

Rectangular leader pipe area = 165 percent of calculated wall stack area.

in which:

L = total equivalent feet of run as follows:

Each foot of leader pipe from furnace to boot = $1L$

Each foot of horizontal duct at other than basement level:

Area not less than calculated stack area = $1.5L$

Area not less than calculated leader pipe area = $1L$

E = number of equivalent elbows as follows:

Each direction change occurring in horizontal or vertical run between furnace and register box shall be considered at its equivalent E value as follows:

Each direction change greater than 45° and not greater than 90° = $1E$

Each direction change greater than 30° and not greater than 45° = $0.5E$

Each direction change greater than 15° and not greater than 30° = $0.25E$

Direction changes less than 15° shall be disregarded.

(3) Minimum leader pipe size: 6 inches diameter round or equivalent.

(4) Minimum stack area: 26 sq. in. with minimum depth of 2½ in. and a width not over 6 times the depth used.

VI–F. Design for Forced Circulation Warm Air Systems. *See also VI–D above.*

1. *General.*

a. Design and install in accordance with the "Code and Manual for the Design and Installation of Warm Air Winter Air Conditioning Systems" of the National Warm Air Heating and Air Conditioning Association, except as otherwse provided in this Appendix.

b. For Heat Loss Calculation see II–A.

c. As a guide, use "Yardstick for Classifying Warm Air Winter Air Conditioning Systems" as published by the N. W. A. H. A. C. A.

NOTE: *Class C in Yardstick will not be acceptable. Materials other than those covered in paragraphs 310 and 311 of the "Yardstick" may be used provided they are acceptable to the Chief Underwriter.*

d. Use of propeller fan requires compliance with requirements for gravity warm air systems. No reduction in duct sizes will be permitted.

2. *Supply and return ducts.*

a. Connect to heater with flexible joint of fireproof material.

b. Air velocities in feet per minute for supply and return shall not exceed 750 in trunks, 600 in branches, and 500 in stacks.

c. Area of rectangular supply ducts shall be in accordance with "Code and Manual for the Design and Installation of Warm Air Winter Air Conditioning Systems."

d. A fresh air intake with an area not less than 20 percent of total required return area should be provided which shall be insect-screened and protected from the weather and connected separately to the return air plenum system through a tight and continuous duct fitted with an accessible tight damper adjustable to all positions from wide open to closed. No reduction in return grille or duct area shall be made because of the use of the cold air intake.

e. Each trunk duct connection shall be made to the sides of the plenum with a transition fitting. The area of the fitting at the intersection with the plenum shall be not less than 1½ times the trunk duct area and the center line of the transition fitting shall be not more than 45° from the horizontal.

f. All changes of direction in trunk, branch and risers shall be made with fittings with an internal radius of not less than 2 inches or properly designed turning vanes shall be used in the fittings.

g. Trunk take-off connections shall be made so that the angle between the center line of the take-off and the center line of the duct is 45° or less.

3. Run a separate riser to each supply register.

4. Top of supply register shall not be more than 7′–0″ above the floor.

VI–G. Plenum Systems.

1. Design and installation shall be as required for forced circulation warm air systems. Top of supply registers shall not be located closer to ceiling than 2 inches.

2. *Supply Plenum.*

a. Use material acceptable to the Chief Underwriter with all joints sealed air-tight.

b. Install register collars not less than 6 inches long, with accessible damper.

3. *Return Plenum.*

a. Crawl space under first floor is acceptable as a return plenum provided the surrounding wall construction is tight, the enclosing structural materials are such that they will not rot or corrode in the presence of moisture, and the ground is surfaced with at least 2 inches of concrete.

b. Basement space is not acceptable as a return plenum.

OVERFLOW HEATERS

VII–A. General. *See III–A.*

VII–B. Space Heaters.

1. *Coal Fired.*

a. Construction.

(1) Coal fired space heaters shall be constructed of cast iron or steel or both. Minimum thickness of cast iron combustion chamber sections or parts in direct contact with flue gases shall be not less than ¼″. Minimum thickness of steel combustion chamber or parts in contact with flue gases shall be not less than No. 10 U. S. S. gauge. Steel combustion chamber shall be lined with a minimum thickness of 1″ of refractory material.

(2) Grates shall be constructed of cast iron and arranged so that they shall not be dislodged during the shaking or dumping operation.

(3) All doors and access openings into the firebox, ashpit, or gas passages shall be provided with paper-tight joints. All handles for doors and dampers shall be designed so as to minimize the danger of burns from personal contact. The firedoor of surface fired heaters shall be protected from the heat of combustion by a suitable liner.

(4) Outside metal surfaces of heaters, grilles, jackets and accessories shall be protected against rust or corrosion.

b. Rating. The maximum and minimum ratings shall be determined in accordance with Tentative Standard for Coal Burning Space Heaters TS–3443, except that the indirect efficiency need not be more than 45 percent.

2. *Oil Fired.*

a. Construction and Rating shall be in accordance with the requirements of Commercial Standard CS–101 "Flue-Connected Oil-Burning Space Heaters Equipped with Vaporizing Pot-Type Burners." See also IX–B.

b. Installation: See III.

3. *Gas Fired.*

a. Construction and Rating shall be in accordance with the American Standards Association Approval Requirements for Gas Space Heaters published by the American Gas Association. See also VIII–A and B.

b. Installation: See III.

VII–C. Floor Furnaces.

1. *General.*

a. Placement. Locate so that no door, drapery, or similar object can be nearer than 12″ to any portion of the floor furnace or register.

b. Installation: In accordance with CS–99.

(1) Bracing. The floor around the furnace shall be braced and headed with a framework of material not lighter than the joists. The inside dimensions of the framework shall be approximately ½ in. longer and wider than the furnace to be installed.

(2) Support. Means shall be provided to support the furnace when the floor grille is removed.

(3) Clearance. The bottom of the floor furnace shall have at least a 6-inch clearance from the ground, obtained, when necessary, by excavating the ground below and to the sides to form a "basin-like" pit under the furnace so that there is a 6-inch clearance beneath the furnace and a 12-inch clearance on all sides, except the control side, which shall have an 18-inch clearance. This facilitates any servicing that may be required and allows ample air for proper combustion.

(4) Seepage pan. Whenever the excavation exceeds 12 inches or water seepage is apparent under the house, a water-tight copper pan, concrete pit, or other suitable material shall be used. A copper pan shall be made of not less than 16 oz. sheet copper. The pan shall extend at least 4 inches above the ground level, with 12-inch clearance from the furnace on all sides except the control side, which shall have 18-inch clearance.

(5) Access. Adequate provision shall be made for easy access to the furnace under the house by means of an opening in the foundation wall or through a trap door of at least 18 x 24 inches, located at some convenient point in the house, and a clear unobstructed passageway to the furnace at

VII–C. Floor Furnaces. *Continued.*

least 24 inches high by 24 inches wide. The local utility should be consulted with reference to the access facilities for servicing where it provides service.

(6) Appliance alterations. All gas floor furnaces, including those having single- or dual-wall register outlets, shall be installed without alterations, extensions, or changes of any kind in the furnace.

(7) Upper-floor installations. Gas floor furnaces may be installed in an upper floor, provided the furnace assembly projects below into a utility room, closet, garage, or similar non-habitable space. In such installations, the furnace shall be enclosed completely, with means for air intake to meet the requirements of Commercial Standard CS–99, with provision for service, with furnace clearances of 6 inches on all sides and bottom, and with the enclosure constructed of portland cement plaster on metal lath or material of equal fire resistance.

(8) Adjustment. All gas floor furnaces except those using liquefied petroleum gases shall be equipped with a gas-pressure regulator, which shall be adjusted and sealed so that the gas input does not exceed the approved input rating.

2. *Oil Fired.* Construction and Rating shall be in accordance with the Requirements of Commercial Standard CS–113 "Oil Burning Floor Furnaces Equipped with Vaporizing Pot-Type Burners."

3. *Gas Fired.* Construction and Rating shall comply with the American Standard Association Approval Requirements for Central Gas Heating Appliances Z–21–13, published by the American Gas Association. See VIII–A and B.

VII–D. Pipeless Furnaces.

1. *General.*

a. Placement. Locate so that no door, drapery, or similar object can be nearer than 12″ to any portion of the floor furnace or register.

b. Installation. See VI–C.

GAS BURNING EQUIPMENT

VIII–A. All gas burning equipment shall comply with Standards of the American Gas Association and evidence of such compliance shall be:

1. Seal of the American Gas Association, or

2. Manufacturer's certification of compliance.

NOTE: *The approval of the local utility may also be required.*.

VIII–B. A. G. A. ratings are determined for installation at sea level. The output rating is to be reduced 5 percent for each 1000 feet above sea level.

VIII–C. Gas piping shall be installed so as to provide a supply of gas sufficient to meet the maximum demand due to simultaneous operation of all gas burning appliances installed. The maximum demand is the sum of the input ratings of all appliances served. The piping is to be sized according to the following tables:

Capacity of Pipe in cu. ft. per hour

Iron Pipe Diameter	*Length of Pipe* 15 ft.	30 ft.
½	76	52
¾	172	120
1	345	241
1¼	750	535
1½	1,220	850

Typical Demand of Common Appliances

Appliance	*Btu per Hour*
Range	62,500
Water Heater	25,000
Instantaneous Water Heater Per gpm	37,500
Room Heater	15,000
Refrigerator	2,000
House Heater	1.40 x house heat loss

VIII–D. Pipe and fittings shall be steel, wrought iron or wrought steel or other materials acceptable to the Chief Underwriter.

VIII–E. Piping shall not be run on or in outside walls. A drip, in which liquid condensate may collect and from which it may be removed shall be provided at any point in the piping where condensate will collect. Drips should not be located where the condensate is likely to freeze.

VIII–F. A tee fitting with the bottom outlet plugged or fitted with short nipple and cap shall be used at the bottom of all risers and drops.

VIII–G. Piping shall not be installed within any air ducts.

VIII–H. Locate meter in accessible and unconfined space and support rigidly.

VIII–I. White lead or other joint compound shall be applied sparingly to the male threads only. In the case of liquefied petroleum gases (propane, butane or butane-air gases) the compounds used in making up joints shall be resistant to the action of such gases.

VIII–J. All branch outlet pipes shall be taken from the top or sides of main lines above the center line.

VIII–K. All connections shall be free from strain.

OIL BURNING EQUIPMENT

IX–A. Mechanical Draft Oil Burners shall comply with the requirement of Commercial Standard CS–75 and evidence of such compliance shall be:

1. Label of the Underwriters' Laboratories specifying that the burner complies with CS–75.

2. Certificate posted on the installation in accordance with CS–75.

3. The firing rate at which the burner is set shall be within the firing range for which the burner has received Underwriters' CS–75 approval (see list of Inspected Gas, Oil and Miscellaneous Appliances), and not more than the firing rate designated on the boiler, furnace, or unit, or as may be designated by the FHA field office. (This requirement supersedes the firing rate requirements, Article 25 (4) of CS–75.)

NOTE: *An oil burner to which air for combustion is supplied by a power-driven fan is to be considered as a Mechanical Draft Oil Burner.*

IX–B. Natural Draft Oil Burners shall comply with the requirements of the Underwriters' Laboratories and evidence of such compliance shall be:

1. Label of the Underwriters' Laboratories, Inc.

2. *Pot-type burners.*
   a. Minimum chimney height, 18 feet above burner.
   b. Maximum length of smoke pipe measured horizontally, 3 feet.
   c. Permissible number of 90 degree smoke pipe elbows, not more than two.

NOTE: *When acceptable to the Chief Underwriter 2 above may be modified, provided suitable tests on a completed installation indicate adequate draft, meeting the requirements of the Underwriters' Laboratories for the equipment installed.*

IX–C. Installation of tank, piping, controls and burner shall comply with the following:

1. *Gravity Feed to Burners.*
   a. Gravity feed shall be used only with burners arranged to prevent abnormal discharge of oil at the burner by automatic means specifically approved for the burner with which it is used.
   b. Gravity supply tanks shall not exceed 275 gallons individual capacity. Where more than one gravity supply tank is used, such tanks shall be connected to the feed pipe leading to the burner through a manually operated, approved three-way valve in such a way that only one tank can discharge its contents at a time.
   c. Where oil is supplied to the burner by gravity and a constant level device is not incorporated in the burner assembly or in an auxiliary tank used in connection with an automatic pump, an approved constant level

device shall be installed in the oil feed line at the gravity tank or as close thereto as practicable, to insure uniform delivery of oil to the burner. The vent opening of such constant level device shall be connected by piping or tubing to the gravity tank vent pipe.

2. *Installation of Underground Tanks.*

a. Oil supply tanks should preferably be located outside of buildings and underground with top of tank below the level of all piping to which the tank is connected, to prevent discharge of oil through a broken pipe or connection by syphoning.

b. Underground tanks shall be so buried as to have a cover of earth not less than 2 feet thick, or shall be covered with not less than 1 foot of earth on top of which shall be placed a slab of reinforced concrete not less than 4 inches thick. The slab shall be set on a firm, well tamped earth foundation and shall extend at least 1 foot beyond the tank in all directions. Where tanks are buried underneath buildings such a concrete slab shall be provided in every instance.

3. *Installation of Tanks Inside Buildings.*

a. Oil supply tanks larger than 60 gallons capacity shall not be located in buildings above the cellar or basement or above the lowest story of a basementless dwelling.

b. Unenclosed inside storage tanks and auxiliary tanks shall not be located within 7 feet, horizontally, of any fire or flame.

c. Oil supply tanks located inside buildings shall not exceed 275 gallons individual capacity or 550 gallons aggregate capacity.

4. *Installation of Outside Tanks above ground.* Tanks shall be enclosed in a manner which is acceptable to the Chief Underwriter.

5. *Setting of Tanks.*

a. Underground tanks shall be set on a firm foundation and surrounded with soft earth or sand well tamped in place. Where necessary to prevent floating they shall be securely anchored or weighted.

b. Inside storage and auxiliary tanks shall be securely supported by substantial incombustible supports to prevent settling, sliding or lifting.

c. Inside storage tanks shall be installed with the bottom pitched to the draw-off or drain opening with a slope of not less than ¼-inch per foot of length. The draw-off or the drain openings shall be provided with suitable piping connections in a form to provide a sump from which water or sediment can be readily drained at regular intervals.

d. Outside above ground tanks shall be set on a firm foundation. Those more than one foot above the ground shall have supports of masonry or protected steel, except that wooden cushions may be used. No combustible material shall be stored under or within 10 feet of outside above ground tanks.

6. *Construction and Coating of Tanks.*

a. Oil supply tanks shall be constructed of steel or wrought iron. The minimum gauge (U. S. Standard) shall be in accordance with the following table:

Capacity Gallons	*Underground and Masonry Enclosed Inside Tanks*	*Inside Tanks*	*Outside Above Ground Tanks*
1 to 60	16	16	18
61 to 180	16	16	16
181 to 275	16	14	16
276 to 285	16		16
286 to 350	14		16
351 to 560	14		14
561 to 1,100	12		12

b. Oil supply tanks shall have an exterior coating as follows, or a suitable equivalent:

Underground tanks—Two coats of asphaltum.
Masonry enclosed inside tanks—One coat of asphaltum.
Inside tanks—Rust inhibiting paint.
Outside above ground tanks—Rust inhibiting paint.

7. *Tank Vents.*

a. Storage tanks shall be equipped with an open vent or an approved automatically operated vent, arranged to discharge to the open air. Vent openings and vent pipes shall be of ample size to prevent abnormal pressure in the tank during filling but not smaller than 1¼ inch pipe size.

NOTE: *Where storage tanks are filled by the use of a pump through tight connections special consideration should be given to the size of the vent pipe to insure that it is adequate to prevent the development of abnormal pressure in the tank during filling. This may be accomplished by providing a vent pipe commensurate in size with the discharge of the pump used or by means of a signaling or limiting device.*

b. Vent pipes shall be arranged to drain to the tank. The lower end of the vent pipe shall not extend through the top into the tank for a distance of more than one inch.

c. Vent pipes shall terminate outside of buildings at a point not less than 2 feet measured vertically or horizontally from any window or other building opening. Outer ends of vent pipes shall be provided with a weatherproof hood. Vent pipes should terminate sufficiently above the ground to prevent their being obstructed with snow and ice.

d. Vent pipes shall not be cross-connected with fill pipes or return lines from burners.

8. *Tank Fill and Overflow Pipes.* Storage tanks shall be filled through fill pipes terminating outside of any enclosing structure at a point at least 5

feet from any opening in the dwelling at the same or lower level. Fill terminals, when not in use, shall be closed tight by a metal cover designed to prevent tampering.

9. *Oil Gauging.*

a. All tanks in which a constant oil level is not maintained by an automatic pump shall be equipped with a method of determining the oil level.

b. Gauging devices such as liquid level indicators or signals, when provided, shall be installed so that oil or vapor will not be discharged into the building from the fuel supply system.

10. *Piping.*

a. All piping shall be standard full weight wrought iron, steel or brass pipe with standard fittings or brass or copper tubing and fittings.

b. Pipe used in the installation shall not be smaller than ¼ inch iron pipe size. Copper or brass tubing shall not be smaller in size than the equivalent of the iron pipe sizes mentioned above, with wall thickness not less than 0.049 inch.

c. Piping shall be rigidly secured in place and protected from injury in a workmanlike manner, and where necessary, shall be protected against corrosion. Where practicable, oil piping shall be buried underground or in a concrete floor.

d. Pipe joints and connections shall be made tight in a workmanlike manner. Unions and tubing fittings shall be of approved type. Unions requiring gaskets or packing, and right and left couplings shall not be used in oil lines.

e. Proper allowance shall be made for expansion, contraction, jarring and vibration. Pipe lines, other than tubing, connected to underground tanks, except fill lines and test wells, shall be provided with double swing joints arranged to permit the tank to settle without impairing the efficiency of the pipe connections.

11. *Valves.* Readily accessible shut-off valves shall be installed in oil supply lines near each burner and close to supply tanks.

12. *Tests of Covered Tanks and Piping.* After installation and before being covered, underground or inaccessible tanks and piping shall be tested hydrostatically, or with equivalent air pressure, at a pressure not less than 1½ times the maximum working pressure but not less than 5 pounds per square inch gauge at the highest point of the system. Instead of a pressure test, suction lines may be tested under a vacuum of not less than 20 inches of mercury. Tests should continue for at least 30 minutes without a noticeable drop in pressure or vacuum.

13. *Installation of the Burner.*

a. Oil burners shall be securely installed in a workmanlike manner, in accordance with the instructions of the manufacturer, by qualified mechanics experienced in making such installations.

b. The burner and combustion chamber shall be installed so that vapors will not accumulate in the portion of the furnace or boiler outside of and below the top of the combustion chamber.

X–A. The capacity of a stoker shall be sufficient to develop the rated output of the equipment in which it is installed and the coal burning rate in lbs. per hour shall be not less than:

$$\frac{\text{Gross output of furnace or boiler}}{.60 \times C}$$

The minimum coal burning rate shall be not more than:

$$\frac{\text{Net Load on furnace or boiler}}{2.4\ C}$$

where

C is the calorific value of the coal used.

X–B. The furnace dimensions shall be not less than shown in the following table:

Max. lbs. per hr.	*Setting Height*	*Base Height*	*Firebox Width*	*Firebox Length*	*Furnace Volume*
15	17½	11½	16½	17	3
20	18	11¾	17¾	19	4
25	18½	12	19	21	5
30	19¼	12	20	23	6

For stokers designed to discharge ash by gravity into the ash pit the clearance between tuyere sides and furnace or boiler shall be not less than 2½ inches.

X–C. Stokers shall be provided with a hopper with a capacity not less than 15 times the maximum burning rate unless bin-feed. The charging edge of hoppers shall be not more than 48″ above the charging floor.

X–D. Anthracite coal stokers shall be constructed and installed in accordance with the requirements of "Domestic Burners for Pennsylvania Anthracite (Underfeed Type) (Current Edition)", Commercial Standards, CS–48.

X–E. Bituminous stokers shall be rated and installed in accordance with the recommendation of the Stoker Manufacturers' Association.

XI–A. General Requirements.

1. Smoke breechings shall have a free area not less than the smoke or vent outlet of the connected appliance, shall be fitted with adequate clean-outs, and shall be constructed of iron or steel in weights not less than the following:

Diameter	*Gauges*
to 12 in.	24
12 in. to 16 in.	20
16 in. to 20 in.	18
20 in. to 30 in.	16
over 30 in.	14

2. Maximum length, 8 feet.

3. Pitch of breeching; upward toward chimney, 1 inch in 4 feet, minimum.

4. Provide acceptable thimble or special breeching connection in chimney.

XI–B. Provide the following dampers and draft controls in the breeching between the smoke outlet and the chimney connection.

1. *Coal Burning Hand Fired.*

a. All equipment. Check damper and turn damper in breeching unless included as integral part of heating device. Turn damper shall have not less than 20% nor more than 25% free opening when in the closed position.

b. Furnaces and space heaters. In addition to the above an automatic draft regulator (barometric or equivalent) permanently set to limit the burning rate to the maximum acceptable rated output of the heater.

2. *Gas Fired Equipment.* Draft diverter on outlet of heater. No turn damper permitted.

3. *Oil fired and stoker fired equipment.* Draft regulator (barometric type) listed by the Underwriters' Laboratories, Inc.

XI–C. Design, Construction and Installation of dampers and regulators shall comply with Recommendations of National Board of Fire Underwriters.

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APPENDIX F

DETAILED DOMESTIC WATER HEATING AND STORAGE REQUIREMENTS

The material under this heading is a part of Domestic Water Heating and Storage 502, compliance with which shall determine acceptability of domestic water heating and storage equipment, and design and installation of such heating and storage systems. Any other method proposed, which, in the opinion of the Chief Underwriter, will result in installations which meet or exceed the performance requirements may be used.

I–A. General.

1. All hot water heaters or systems shall be valved in a manner to provide control separate from the cold water supply system.

2. *Pressure and Temperature Relief Valves.*

a. Protect water heater installation against excessive temperatures and pressures as follows:

(1) For direct fired* systems using oil or gas burning heaters which are equipped with a thermostatic shut-off of the main fuel supply: Install in a supply line near the tank or directly in a tank tapping a pressure relief valve set to operate at not more than 20 pounds above highest normal water pressure.

(2) For all other direct fired* systems: Install a pressure relief valve as described in (1) above, and install in the main hot water supply line within 5 inches of the tank outlet or directly in a tapping on top of the tank a temperature relief valve set to relieve at a temperature not higher than 220° F. A combination temperature and pressure relief valve may be used in lieu of separate valves.

(3) No valve or other device which may interfere with flow shall be installed between any relief valve and the tank or heater which the relief valve serves.

* A direct fired system is one in which the water heating coil or surface is exposed directly to flame or hot gases. An indirect system is one in which the water heating coil or surface does not come in contact with the flame or hot gases but is exposed to an intermediate heating medium such as water or steam which is, in turn, heated by the flame or hot gases.

b. Construction, Relieving Capacity, and Installation.

(1) The construction and relieving capacity rating of relief valves shall conform to the standards of the American Society of Mechanical Engineers. Each shall bear the manufacturer's name or trade mark, type, style, pressure, or temperature or vacuum setting and the relieving capacity.

(2) Regardless of storage capacity installed the relieving capacity of temperature relief valves in gallons per hour or in thousands of Btu per hour shall not be less than the recovery capacity in gallons per hour at 100° rise for coal fired heaters or one-half the recovery capacity in gallons per hour 100° rise for gas or oil fired heaters.

3. Indirect water heating surface heated by the heating boiler is not acceptable as only source of domestic hot water unless heating boiler is automatically fired and controlled so as to provide winter house heating and year-round hot water independently of one another according to their individual demands.

4. Breechings and dampers shall comply with XI–A, B, C of Appendix E.

5. Chimneys, flues and vents shall comply with 503–A, B, C.; and IX–B of Appendix E.

6. Pumps on circulating lines shall be thermostatically controlled.

I–B. Storage Tanks.

1. Storage capacity per living unit may be selected as desired provided it complies with the provisions of Table I.

2. *Materials and construction.*

a. Steel tanks shall be "extra heavy" weight and shall be welded or riveted, or both welded and riveted.

b. Tanks of 120 gallons capacity or less shall be nonferrous material or shall be coated with corrosion-resistant material, such as zinc or porcelain enamel, glass or cement lined.

c. Tanks should be insulated with material having an overall conductance of not more than 0.67 Btu.

d. Nonferrous tanks shall comply with the specifications of the "Non-Ferrous Water Tank Manufacturers Association, Inc."

I–C. Water Heaters. Construction, installation and performance shall be as follows:

a. Installation, all types. All piping of circulating lines between heaters and storage tanks and between indirect heaters and heating boilers shall be maintained throughout at the full size of the heater tappings. Changes of direction in piping shall be kept to a practicable minimum and shall be made wherever possible with fittings of less than 90°. All piping shall be fully reamed and joint compound applied to male threads only.

b. Gas Fired. Comply with Standards and Approval Requirements of American Gas Association.

(1) Evidence of Compliance. A. G. A. seal or manufacturer's written certification that equipment conforms to applicable A. G. A. Standards and

I–C. Water Heaters. *Continued.*

Approval Requirements. The approval of the local utility company also may be required.

(2) A. G. A. ratings are indicated as Btu input or in gallons per hour raised 60° F. determined on the basis of 1192 Btu input per gallon per 100° rise for sea level installations. Appliances shall be selected on basis of output reduced 5 percent for each 1,000 feet above sea level. Gallons per hour raised 60° may be converted to gallons per hour raised 100° by multiplying by 0.60.

c. Oil burning heaters shall comply with the applicable provisions of IX–A, B, C of Appendix E.

d. Coal burning heaters shall be rated in accordance with the Recommended Commercial Standard for Testing and Rating Hand Fired Hot Water Supply Boilers TS–3560a and with the superseding Commercial Standard.

e. Indirect Heaters. Recovery capacity of all indirect heaters shall be based on boiler water temperature not over 180° F.

I–D. Capacity of Domestic Water Heating Equipment. Heater Recovery Capacity in gallons per hour raised 100° F. shall be not less than shown for the corresponding selected storage capacity in the following table:

TABLE I

Required Water Heater Recovery Capacities for Tankless Heaters and for Heaters with Various Storage Tank Sizes

*Storage Tank Size** (*Gallons*)	*Equivalent Recovery–gph–100° Rise*	
	1 living unit	*2 living units*
0 (Tankless)	180. 0	300. 0
20	22. 5	----
25	20. 0	----
30	17. 5	----
35	15. 0	----
40	12. 5	40. 0
45	10. 0	37. 5
50	7. 5	35. 0
55	5. 0	32. 5
60	5. 0	30. 0
65	5. 0	27. 5
70	5. 0	25. 0
80	5. 0	20. 0
90	5. 0	15. 0
100 or over	5. 0	10. 0

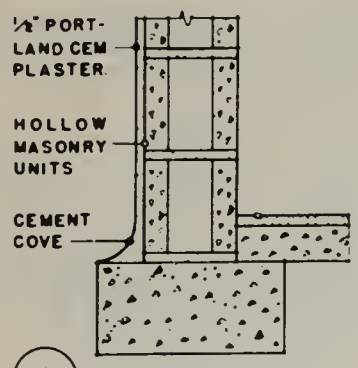
*Minimum acceptable tank capacity except where tankless system is used:

a. For indirect or automatically fired heater serving 1 living unit, 20 gallons.

b. For direct hand fired or manually controlled heater serving 1 living unit, 30 gallons.

c. For any heater serving 2 living units, 40 gallons.

SUGGESTED CONSTRUCTION DETAILS



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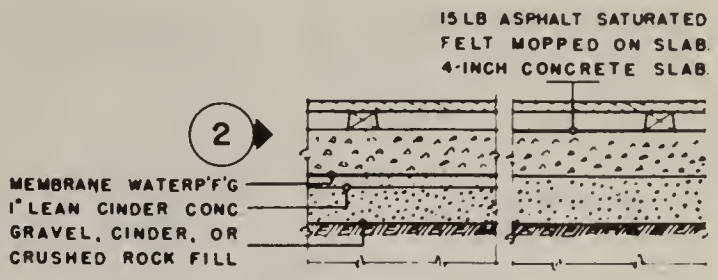
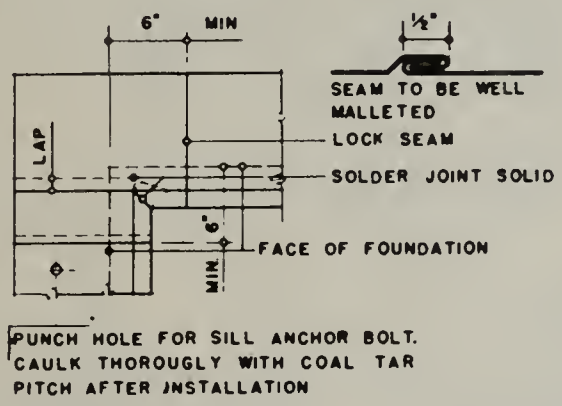


· WOOD · FLOOR · OVER ·
· SLAB · ON · GROUND ·

3



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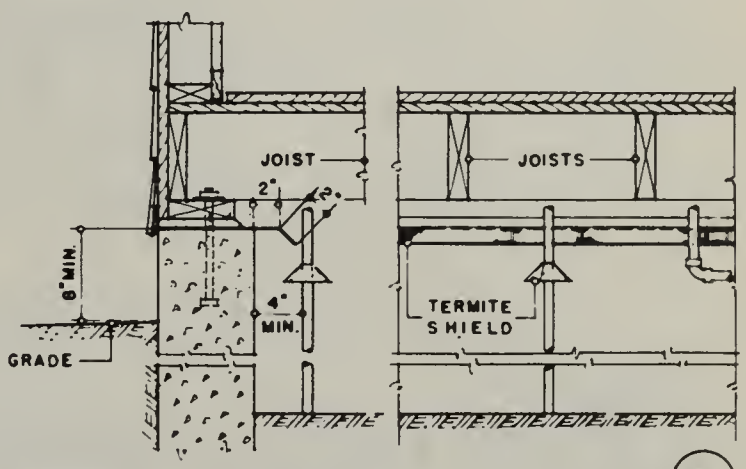

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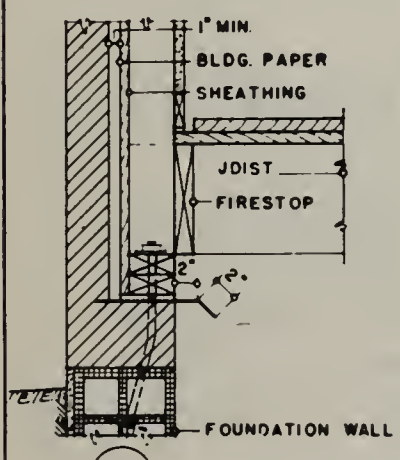

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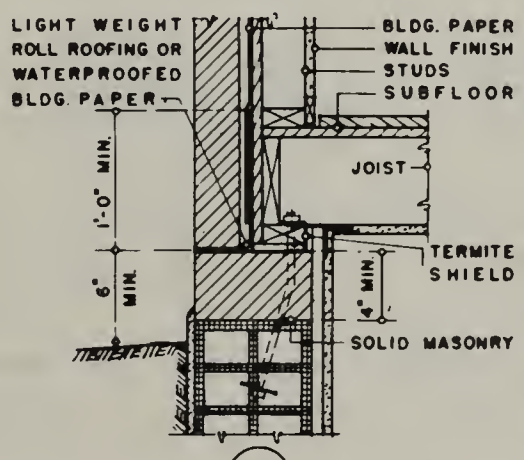

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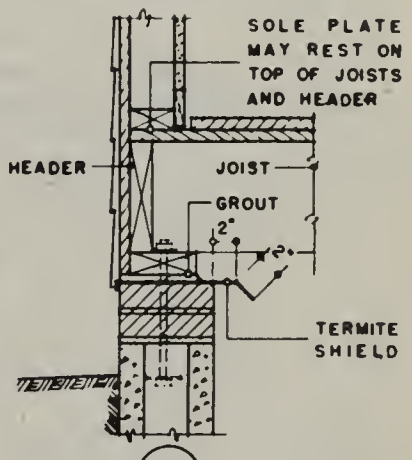

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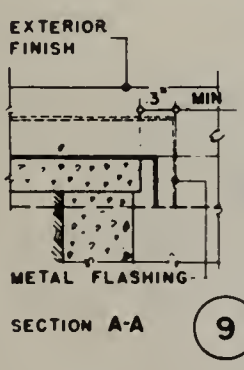

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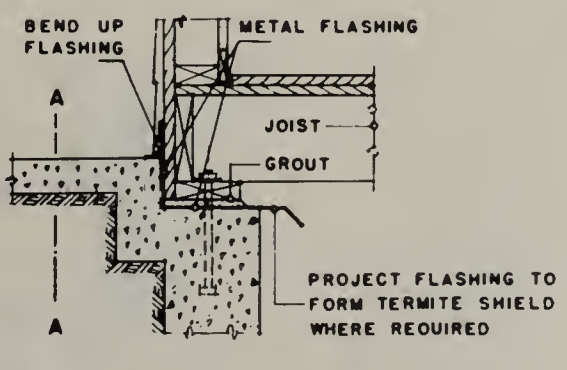

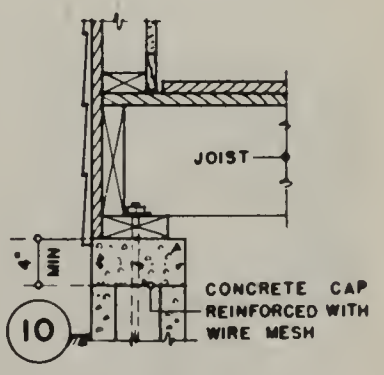

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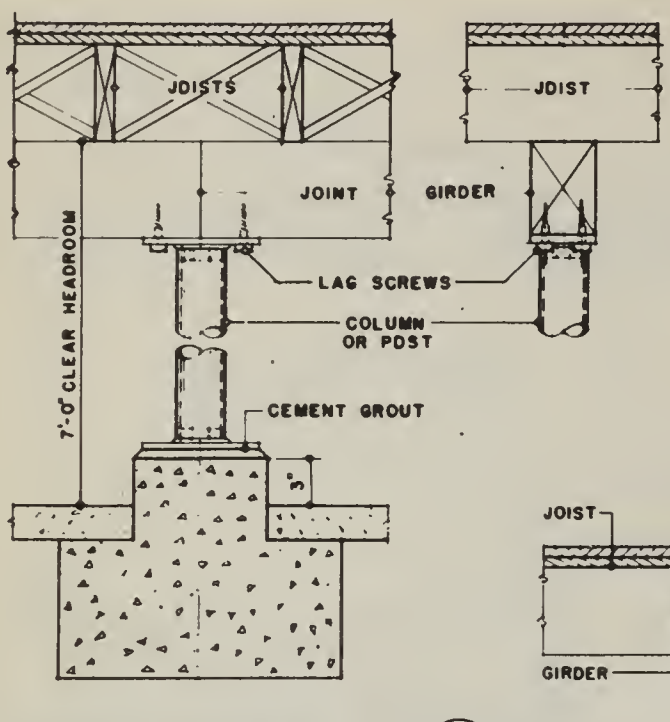
· FLASHING · AT · FILLED · PORCH · OR · TERRACE ·

· SILL · CONSTRUCTION ·

Details 1–10

SUGGESTED CONSTRUCTION DETAILS



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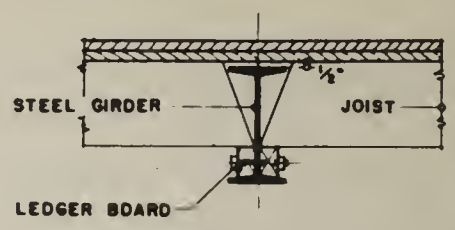
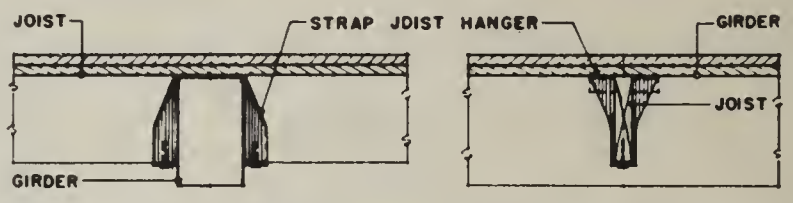
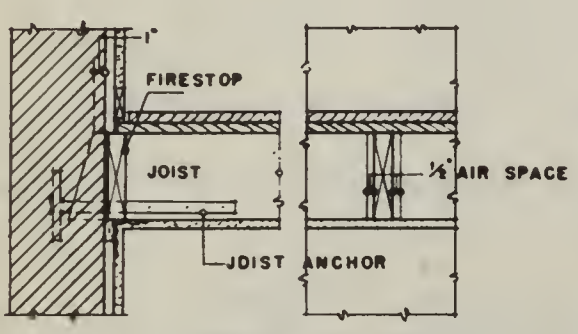


·JOISTS · FRAMING · ON · ·BOTTOM · FLANGE · OF · ·STEEL · GIRDER·

(12)

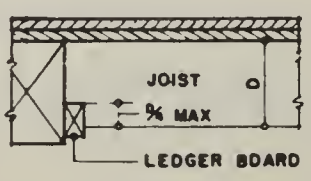


(13) ·METAL · JOIST · HANGER·



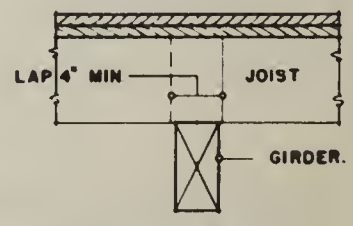
·JOISTS · FRAMING · ·INTO · MASONRY · WALLS·

(14)



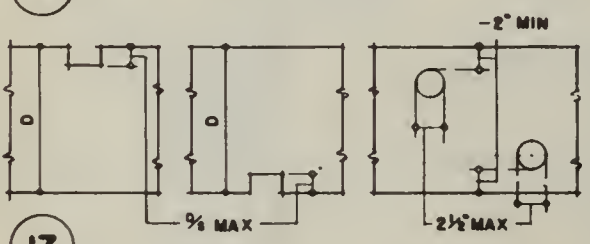
·JOIST · FRAMING· INTO GIRDERS, HEADERS, & TRIMMERS.

(15)



·JOIST · LAP · ·OVER · GIRDER·

(16)



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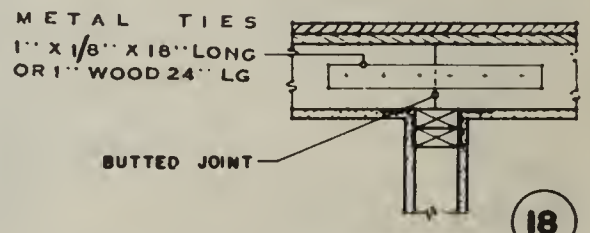
·CUTTING · JOISTS · FOR · PIPING·



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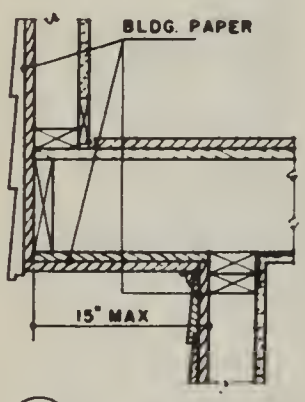
·JOIST · TIE · AT · BUTTED · JOINT·



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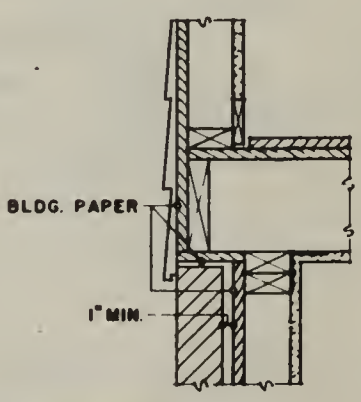

(20)

·CANTILEVERED · OVERHANG·

Details 11–20

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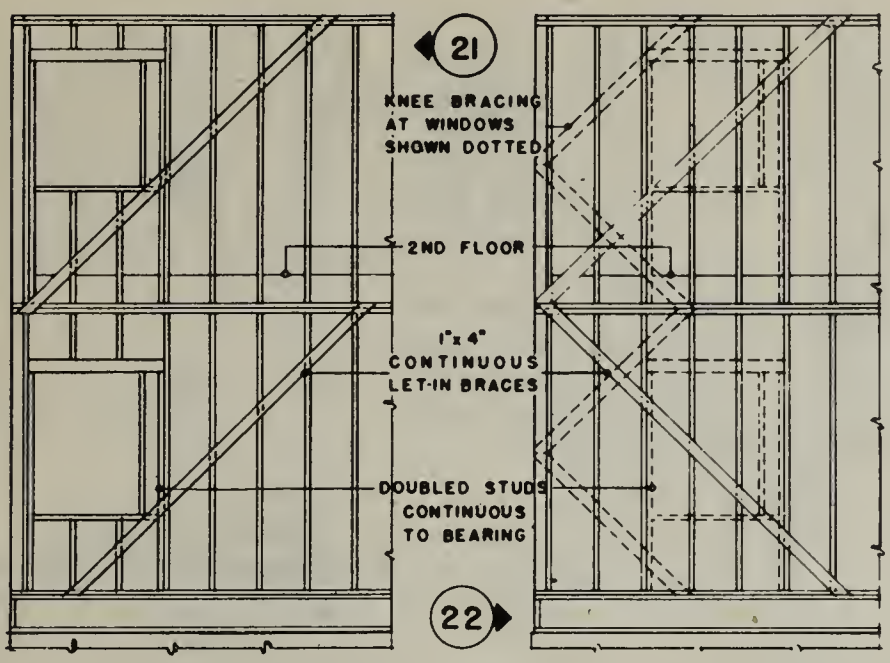
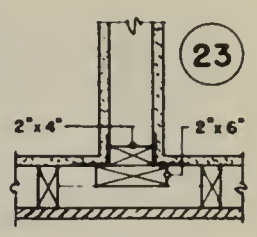
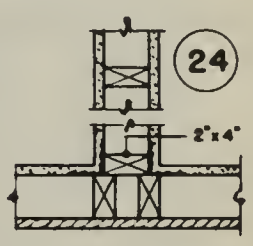


·ELEVATION · OF · CORNER · BRACING·



·PARTITION · CORNER·



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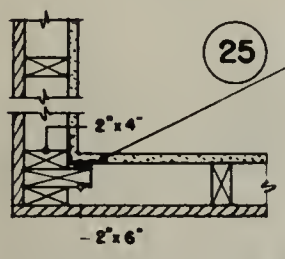

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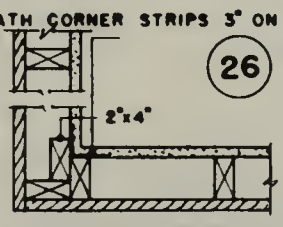

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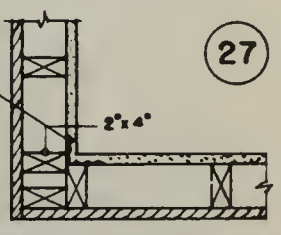

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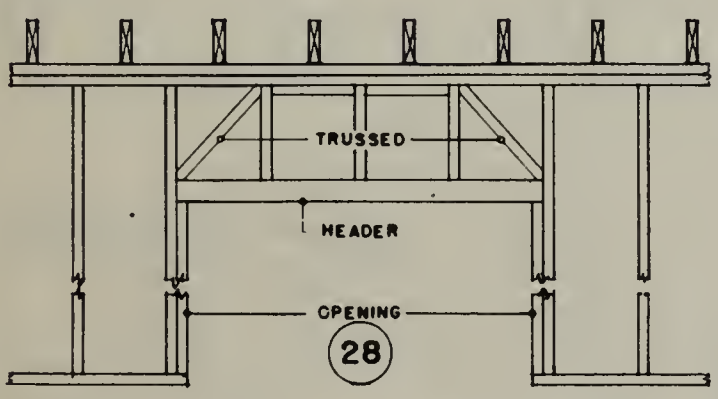
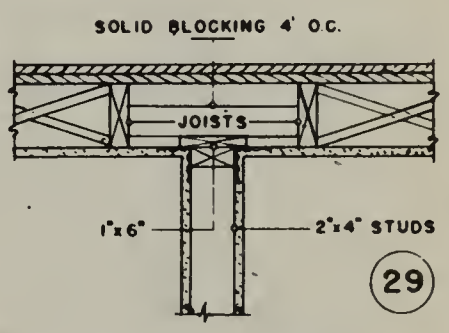
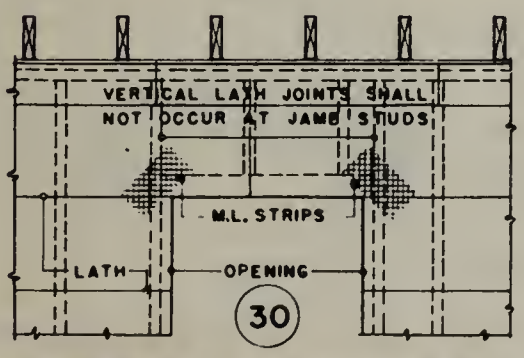


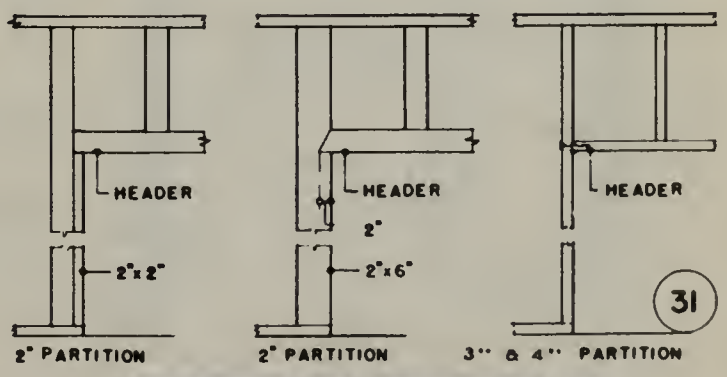
·TRUSSED · HEADER · FOR · WIDE · OPENINGS·



·NONBEARING · PARTITION · PARALLEL · TO · CEILING · JOISTS·



·BOARD · LATH · JOINTING · AT · HEAD · OF · OPENING·



·FRAMING · OF · OPENINGS · IN · NONBEARING · PARTITIONS·

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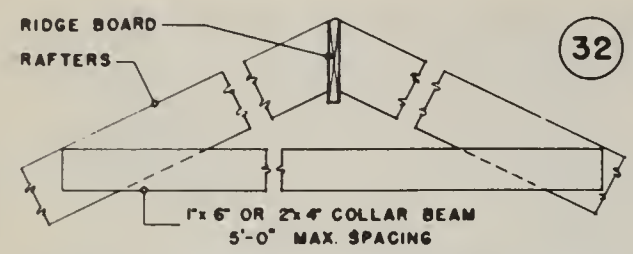
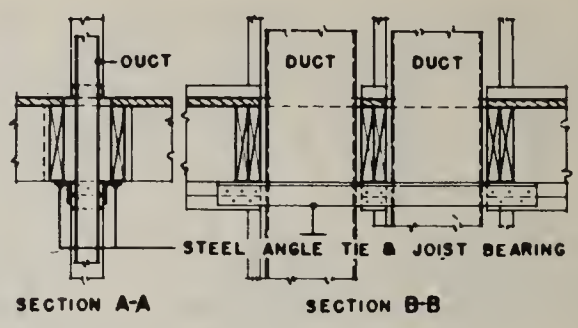


32

·RIDGE·BOARD·AND·COLLAR·BEAM·



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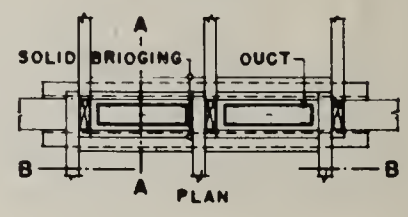
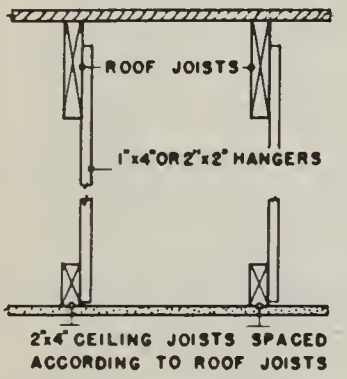


·JOIST·BEARING·AND·
·PLATE·REINFORCING·



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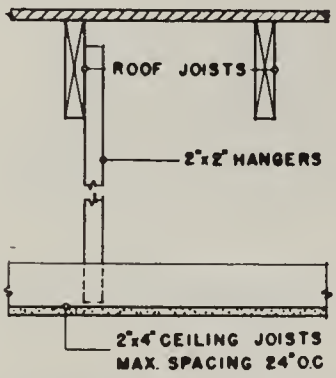

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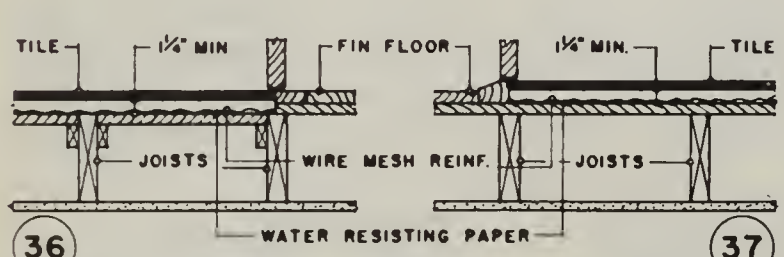
·HUNG·CEILING·FRAMING·



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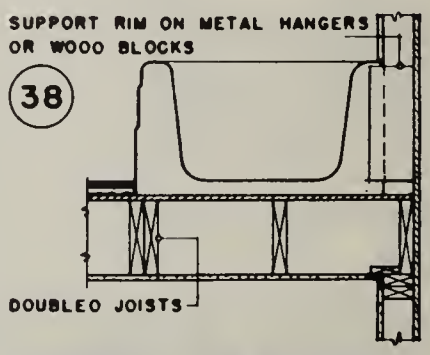
·TILE·FLOOR·ON·WOOD·CONSTRUCTION·



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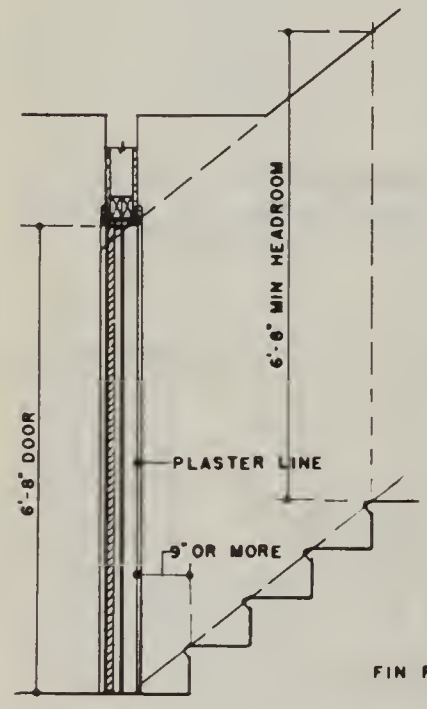
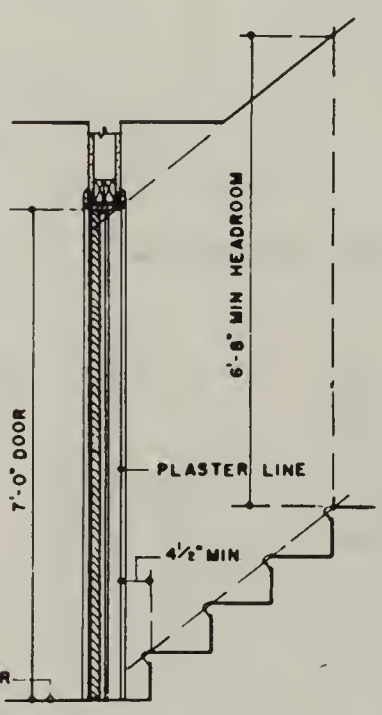
·BATH·TUB·SUPPORT·

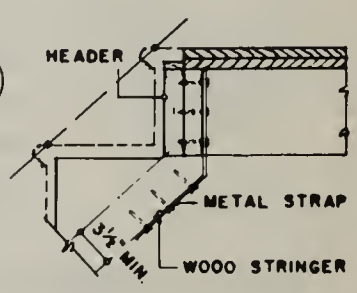




39

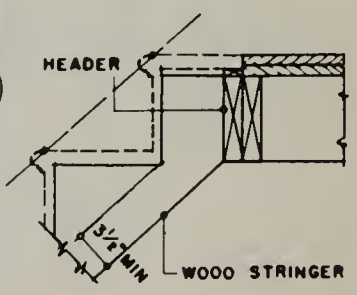
·HEADROOM·AT·DOOR·NEAR·
·FOOT·OF·MAIN·STAIRS·

40



41

·STRINGER·FRAMING·
·AT·HEAD·OF·STAIRS·



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·STRINGER·FRAMING·
·AT·HEAD·OF·STAIRS·

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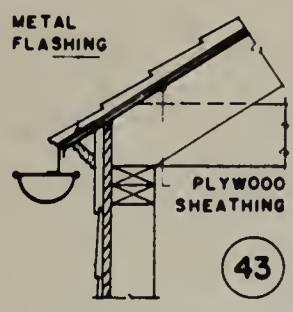
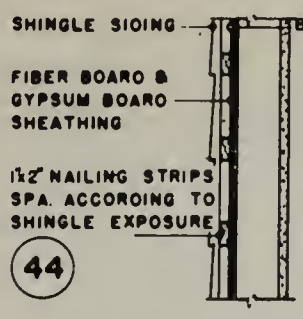
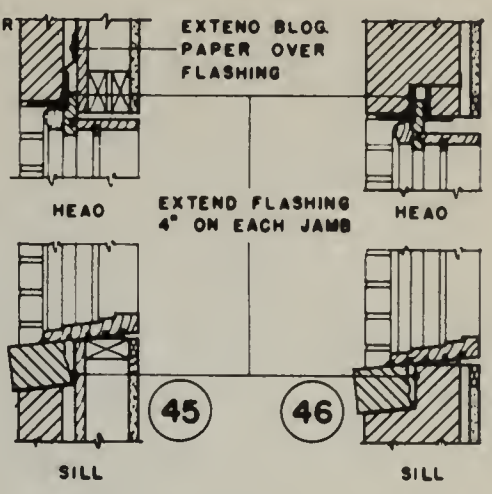
SUGGESTED CONSTRUCTION DETAILS



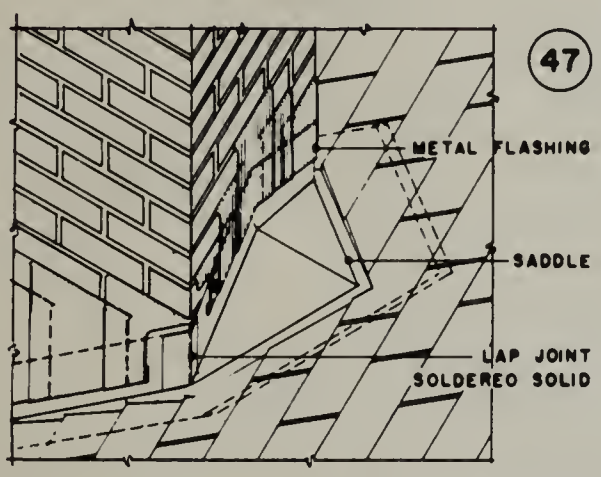
·PLYWOOD·SHEATHING·
·EAVE·DETAIL·



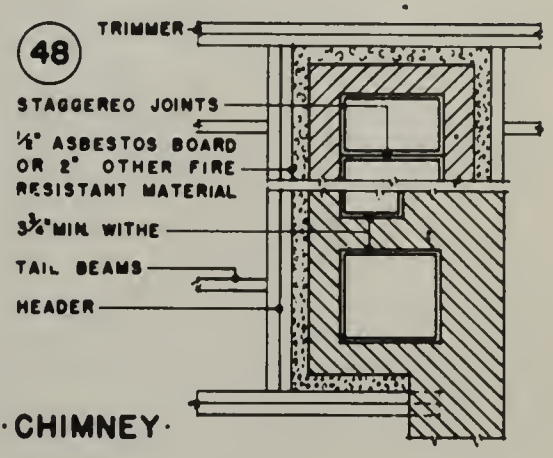
·NAILING·STRIPS·
·OVER·FIBER·AND·
·GYPSUM·SHEATHING·



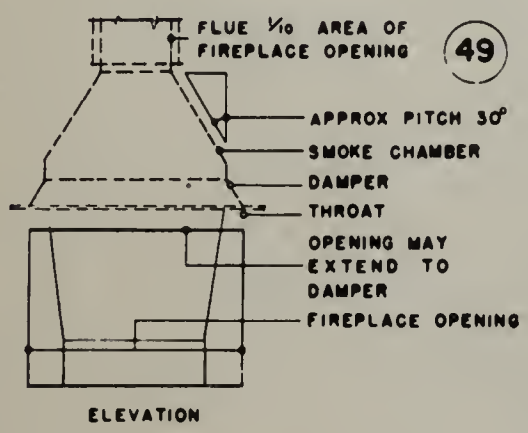
·WINDOW·FLASHING·

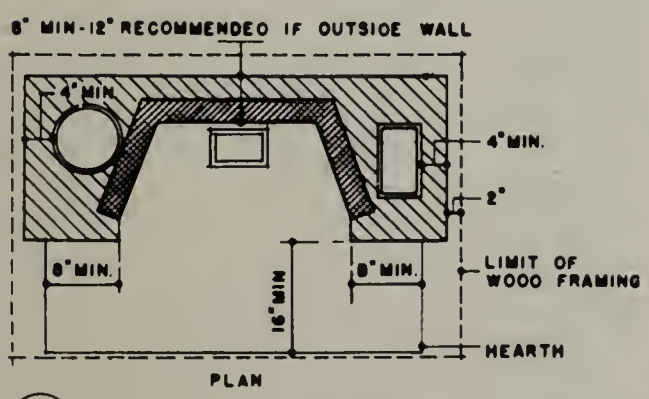


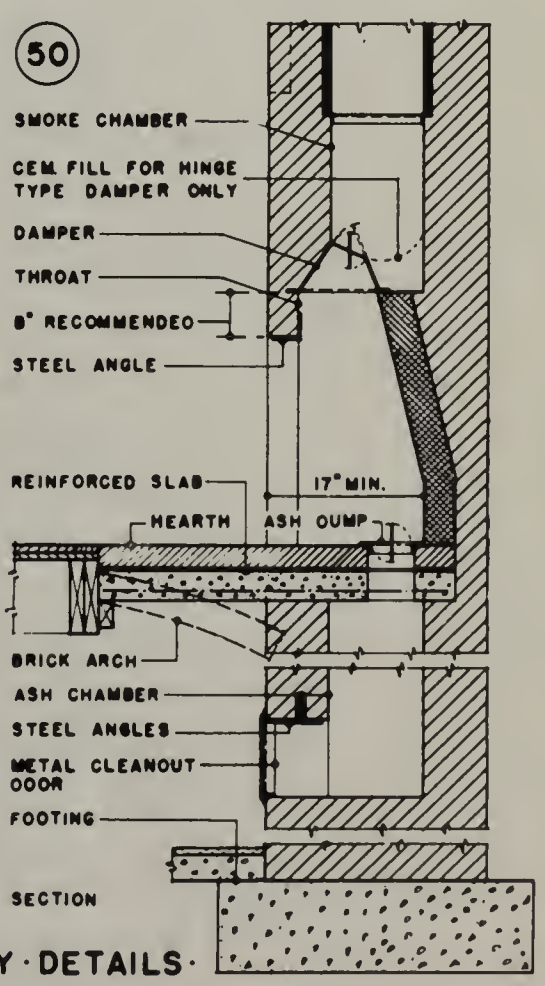
·CHIMNEY·SADDLE·&·FLASHING·



·CHIMNEY·







·FIREPLACE·AND·CHIMNEY·DETAILS·

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